FACULTY OF SCIENCES

SYLLABUS

FOR

Chemistry

Session: 2015-16

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

(ii) Subject to change in the syllabi at any time.
Please visit the College website time to time.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

Index:

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

Index:

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

Index:

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (Semester-I)

Inorganic Chemistry-I

Time: 3 Hrs. **Marks: 30**

45 Hrs (3 Hrs/week) **Internal Assessment: 7**

The question paper shall consist of two parts as detailed below:–

Part A :- (Compulsory)

It shall consist of 6 very short answer type questions (Q. Nos. 1 to 6) from the entire syllabus and
the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. **6 x 1 = 6 Marks**

Part B:-

It shall consist of three sections (Section I, II & III). It shall consist of 9 questions
(Q. Nos. 7 to 15) from the entire syllabus. Each Section will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate
will attempt two questions from each section. Each question will be carrying four mark.
6 x 4 = 24 Marks

SECTION–I

I. Atomic Structure 15 Hrs.

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger
wave equation, significance of ψ 1 and ψ 2, quantum numbers, radial and angular wave functions
and probability distribution curves, shapes of s,p,d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements and ions.

II. Periodic Properties

Position of elements in the periodic table; effective nuclear charge and its calculations. Atomic and ionic radii, ionization energy, electron affinity and electronegativity –definition, methods of
determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

SECTION–II

III. Chemical Bonding 15 Hrs

Covalent Bond –Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. BeF2
,
BF3, CH4, PF5, SF6, IF7, SnCI2, XeF4, BF4, SnC16. Valence shell electron pair repulsion (VSEPR) theory to NH3, H3O+, SF4, CIF3, ICl2 and H2O. MO theory, homonuclear (elements and ions of 1st and 2nd row), and heteronuclear (BO, CN–, CO, NO+, CO+, CN), diatomic molecules, multicenter bonding in electron deficient molecule (Boranes). Percentage ionic character from dipole moment and electronegativity difference.

SECTION–III

IV. **Ionic Solids 15 Hrs**

Concept of close packing, Ionic structures, (NaCI type, Zinc blende, Wurtzite, CaF2 and antifluorite, radius ratio rule and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born–Haber cycle, solvation energy and solubility of

ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic –b ofnrede electron, valence bond and band theories.

Weak Interactions –Hydrogen bonding, Vander Waals forces.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (Semester-I)

ORGANIC CHEMISTRY–I

Time: 3 Hrs. **Marks: 30**

45 Hrs (3 Hrs/week) **Internal Assessment: 7**

The question paper shall consist of two parts as detailed below:–

Part A :- (Compulsory)

It shall consist of 6 very short answer type questions (Q. Nos. 1 to 6) from the entire syllabus and
the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. **6 x 1 = 6 Marks**

Part B:-

It shall consist of three sections (Section I, II & III). It shall consist of 9 questions
(Q. Nos. 7 to 15) from the entire syllabus. Each Section will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate
will attempt two questions from each section. Each question will be carrying four mark.
6 x 4 = 24 Marks

SECTION–I

I. Structure and Bonding (5 Hrs.)

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Vander Waals interactions, resonance, hyperconjugation, aromticity hydrogen bonding and
Inductive and electrometric effects.

II. Mechanism of Organic Reactions (6 Hrs.)

Curved arrow notation, drawing electron movements with arrows, half–headed and double–headed arrows, homolytic and heterolytic bond breaking. Types of reagents – electrophiles and nucleophiles. Types of organic reactions.Energy considerations.Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arenes and nitrenes(with examples). Assigning formal charges on intermediates and other ionic species.

III. Alkanes (4 Hrs.)

Isomerism in alkanes, sources, methods of formation (with special reference to Wurtz reaction,
Kolbe reaction, Corey–House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes:
orientation, reactivity and selectivity.

SECTION–II

IV. Cycloalkanes: (5 Hrs.)

Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane andcyclobutane), theory of strainless rings. The case of cyclopropane ring : banana bonds.

V. Arenes and Aromaticity (10 Hrs.)

Nomenclature of benzene derivatives.The aryl group.Aromatic nucleus and side chain. Structure of benzene: Molecular formula and Kekule structure. Stability and carbon carbon bond
lengths of benzene, resonance structure, MO picture.Aromaticity : the Huckel's rule, aromatic ions.Aromatic electrophilic substitution–general pattern of the mechanism, role of σ and π complexes.Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel Crafts reaction.Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/pararatio.Side chain reactions of benzene derivatives. Methods of formation and chemical
reactions o f alkylbenzenes.

SECTION–III

VI. Stereochemistry of Organic Compounds (15 Hrs.)

Concept of isomerism.Types of isomerism. Optical isomerism, elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers,
chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diasteremers, meso compounds, resolution of enantiomers, inversion, retention and racemization.

Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

Geometric isomerism–determination of configuration of geometric isomers. E & Z system of nomenclature. Conformational isomerism–conformational analysis of ethane and n–butane; conformation of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and flying wedge
formulae. Difference between configuration and conformation.

B.Sc. (Semester-I)
CHEMISTRY PRACTICAL-I

Duration: 3½ Hrs. Marks: 20

6 Period/Week

Inorganic Chemistry: Semi Micro analysis. Cation analysis, Separation and identification of ions from groups I, II, III, IV, V, and VI. Anionic analysis.Four ions with no interference.

Organic Chemistry Laboratory Techniques
Determination of Melting Point
Naphthalene 80-82^{o}C Cinnamic acid 132.5-133^{o}C
Benzoic acid 121.5-122^{o}C Salicylic acid 157.5-158^{o}C
Urea 132.5-133^{o}C Acetanilide 113.5-114^{o}C
Succinic Acid 184.5-185^{o}C m-dinitro benzene 90^{o}C
p–dichlorobenzene 52^{o}C Aspirin 135^{o}C

Determination of Boiling Point
Ethanol 78^{o}C Cyclo Hexane 81.4^{o}C,
Benzene-80^{o}C Toluene 110°C

Practical Examination
1) Inorganic Mixture 18
2) Melting Point/Boiling point of organic substance 05
3) Viva–Voce 04
4) Note Book 03

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (Semester-II)

INORGANIC CHEMISTRY–II

Time: 3 Hrs. **Marks: 30**

45 Hrs (3 Hrs/week) **Internal Assessment: 7**

The question paper shall consist of two parts as detailed below:–

Part A :- (Compulsory)

It shall consist of 6 very short answer type questions (Q. Nos. 1 to 6) from the entire syllabus and
the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. **6 x 1 = 6 Marks**

Part B:-

It shall consist of three sections (Section I, II & III). It shall consist of 9 questions
(Q. Nos. 7 to 15) from the entire syllabus. Each Section will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate
will attempt two questions from each section. Each question will be carrying four mark.

6 x 4 = 24 Marks

SECTION–I

I. p–Block Elements–I **15 Hrs.**

Comparative study (including diagonal relationship) of groups 13–17 elements, compounds like
hydrides, oxides, oxyacids and halides of groups 13–16, hydrides of boron–diborane and higher
boranes, Borazine, borohydrides, fullerenes.

SECTION–II

II. s-Block Elements **15 hs.**

Comparative studies, diagonal relationship, salient features of hydrides, salvation and complexation tendencies.

III. p–Block Elements-II

Carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties
of halogens, interhalogens and polyhalide **,** Silicones and phosphazenes as examples of inorganic
polymers, nature of bonding in triphosphazenes.

IV. Acids and Bases

Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases.

SECTION–III

V. Chemistry of Transition Elements **15 Hrs.**

Characteristic properties of *d*–block elements. Properties of the elements of the first transition

series, their simple compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. General characteristics of elements of Second and Third Transition Series, comparative treatment with their *3*d analogues in respect of ionic radii,
oxidation states, magnetic behaviour.

B.Sc. (Semester-II)

PHYSICAL CHEMISTRY–I

Time: 3 Hrs. **Marks: 30**
45 Hrs (3 Hrs/week) **Internal Assessment: 7**

The question paper shall consist of two parts as detailed below:–
Part A :- (Compulsory)
It shall consist of 6 very short answer type questions (Q. Nos. 1 to 6) from the entire syllabus and
the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. **6 x 1 = 6 Marks**

Part B:-
It shall consist of three sections (Section I, II & III). It shall consist of 9 questions
(Q. Nos. 7 to 15) from the entire syllabus. Each Section will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate
will attempt two questions from each section. Each question will be carrying four mark.
6 x 4 = 24 Marks
Note: Log table and scientific calculators are allowed

SECTION–I

I. Gaseous States 15 Hrs.
Postulates of kinetic theory of gases, deviation from ideal behaviour, van der Waal's equation of state.
Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of van der
Waal's equation, relationship between critical constants and van der Waals constants, the law of
corresponding states, reduced equation of state.
Molecular Velocities: Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases

SECTION–II

II. Liquid State 10 Hrs.
Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals: Difference between liquids crystal, solid and

liquid.Classification, structure of nematic and cholestric phases.Thermography and seven segment cell.

III. Colloidal State 5 Hrs.

Definition of colloids, classification of colloids. Solids in liquids (Sol): kinetic, optical and electrical, properties, stability of colloids,protective action, Hardy Schulze law, gold number. Liquids in liquids (emulsions): Types of emulsions, preparation. Emulsifiers.general applications of colloids.

SECTION–III

IV. Solutions, Dilute Solutions and Colligative Properties 15 Hrs.

Ideal and non–ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, Law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point, Thermodynamic derivation of relation between molecular
weight and elevation in boiling point and depression in freezing point. Experimental methods for
determining various colligative properties. Abnormal molar mass degree of dissociation and association of solutes.

Duration: 3½ Hrs. Marks: 20

6 Period/Week

Crystalisation:
Concept of indication of crystalisation. Phthalic acid from hot water (using fluted filter paper &
stem less funnel)
Acetanilide from boiling water.
Naphthalene from Ethanol
Benzoic acid from water

Physical Chemistry
1. To determine the specific reaction rate of hydrolysis of ethyl acetate catalysed by Hydrogenions at room temperature.
2. To study the effect of acid strength on hydrolysis of an ester.

Viscosity, Surface Tension (Pure Liquids)
3. To study the viscosity and surface tension of CCI glycerine solution in water.
4. To determine the solubility of benzoic acid at different temperatures and to determine H of the dissolution process.
5. To determine the enthalpy of neutralisation of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.
6. To determine the enthalpy of dissolution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber cycle.

Practical Examination: Marks
1) Crystalisation 05
2) Physical Experiment 18
3) Viva–Voce 04
4) Note Book 03

B.Sc. (Semester-III)
ORGANIC CHEMISTRY–II

Time: 3 Hrs. **Marks: 30**

45 Hrs (3 Hrs/week) **Internal Assessment: 7**

The question paper shall consist of two parts as detailed below:–

Part A :- (Compulsory)

It shall consist of 6 very short answer type questions (Q. Nos. 1 to 6) from the entire syllabus and
the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. **6 x 1 = 6 Marks**

Part B:-

It shall consist of three sections (Section I, II & III). It shall consist of 9 questions
(Q. Nos. 7 to 15) from the entire syllabus. Each Section will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate
will attempt two questions from each section. Each question will be carrying four mark.
6 x 4 = 24 Marks

SECTION-I

I. Alkenes and Alkynes (8 Hrs.)

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule,
Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions
of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$.
Substitution at the allylic and vinylic positions of alkenes.Nomenclature, structure and bonding in alkynes. Methods of formation.Chemical reactions ofalkynes, acidity of alkynes.Mechanism of electrophilic and nucleophilic addition reactions,hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.

II. Alkyl and Aryl Halides (7 Hrs.)

Nomenclature and classes of alkyl halides, chemical reactions. Mechanisms of nucleophilic substitution reaction of alkyl halides, SN_2 and SN_1 reactions with energy profile diagrams. Nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides
vs allyl, vinyl and aryl halides.

SECTION-II

III. Alcohols (8 Hrs.)

Classification and nomenclature.Monohydric alcohols—nomenclature.Acidic nature. Reactions
of alcohols. Dihydric alcohols-nomenclature, methods of formation, chemical reactions of

vicinal glycols, oxidative cleavage [$Pb(OAC)_4$] and [HIO_4] and pinacol-pinacolonerearrangement.

IV. Phenols (7 Hrs.)

Nomenclature, structure and bonding, Preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols-electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis,
Reimer Tiemann reaction.

SECTION-III

V. Aldehydes and Ketones (15 Hrs.)

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and
ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condens a t ions. Condensation with ammoni a and its derivatives. Witting reaction.Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction. MPV, Clemmensen, Wolff-Kishner, $LIAIH_4$ and $NaBH_4$ reductions. Halogenation of enolizable
ketones. Halogenation of enoliable ketones.

B.Sc. (Semester-III)

PHYSICAL CHEMISTRY–II

Time: 3 Hrs. **Marks: 30**

45 Hrs (3 Hrs/week) **Internal Assessment: 7**

The question paper shall consist of two parts as detailed below:–

Part A :- (Compulsory)

It shall consist of 6 very short answer type questions (Q. Nos. 1 to 6) from the entire syllabus and
the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. **6 x 1 = 6 Marks**

Part B:-

It shall consist of three sections (Section I, II & III). It shall consist of 9 questions
(Q. Nos. 7 to 15) from the entire syllabus. Each Section will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate
will attempt two questions from each section. Each question will be carrying four mark.
6 x 4 = 24 Marks

SECTION-I

1. Thermodynamics-I 15 Hrs.

Definition of thermodynamic terms: System, surroundings etc. Types of systems, intensive and
extensive properties. State and path functions and their differentials.Thermodynamic process. Concept of heat and work.

First Law of Thermodynamics: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law-Joule-Thomson coefficient and inversion temperature, Calculation of w,q,dU& dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Thermochemistry: Standard state, standard enthalpy of formation-Hess's Law of heat summation
and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

SECTION-II

II. Thermodynamics-II & III 15 Hrs.

Second Law of Thermodynamics: Need for the law, different statements of the law, Carnot cycle
and its efficiency, Carnot theorem. Thermodynamic scale of temperature.

Concept of Entropy : Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality, entropy as a criteria
of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Third Law of Thermodynamics: Nernst heat theorem, statement and concept of residual entropy,
evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for

thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of
G and A with P,V and T.

SECTION-III

Equilibrium

III. Chemical Equilibrium 5 Hrs.

Equilibrium constant and free energy.Thermodynamic derivation of law of mass action. Determination of Kp, Kc, Ka and their relationship, Clausius-Clapeyron equation, applications.

IV Introduction to Phase Equilibrium 10 Hrs.

Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO2 and S systems. Phase equilibria of two component systems-solid-liquid equilibria, simple eutectic-Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H2O), FaCl3-H2O) and CuSO4-H2O) system. Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-Ideal liquid mixtures, Raoult's and Henry's law.Non-ideal system-azeotropes-HCl-H2O and ethanol-water system. Partially miscible liquids Phenol-water, trines-thylamin-water, Nicotine-water System. Lower and upper consulate temperature, Effect of impurity on consolute temperature, immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation and applications.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (Semester-III)

CHEMISTRY PRACTICAL-III

Duration: 3½ Hrs. **Marks: 20**

6 Period/Week

Quantitative Analysis

Volumetric Analysis

a. Determination of acetic acid in commercial vinegar using NaOH.
b. Determination of alkali content-antacid tablet using HCI.
c. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
d. Estimation of hardness of water by EDTA.
e. Estimation of ferrous and ferric by dichromate method.
f. Estimation of copper using sodiumthiosulphate.

Gravimetric Analysis

Analysis of Cu as CuSCN and Ni as Ni (dimethylgloxime)

Organic Chemistry Laboratory Techniques

Thin Layer Chromatography

Determination of Rf values and identification of organic compounds.
a. Separation of green leaf pigments (spinach leaves may be used).
b. Preparation and separation of 2, 4. dinitrophenylhydrazones of acetone, 2-butone, 2-Butanone,
hexan-2 and 3-one using toluene and light petroleum (40 : 60).
c. Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5).

Practical Examination

1) Volumetry / Gravimetry 16
2) Thin Layer chromatography 07
3) Viva-Voce 04
4) Note Book 03

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (Semester-IV)

INORGANIC CHEMISTRY–III

Time: 3 Hrs. **Marks: 30**

45 Hrs (3 Hrs/week) **Internal Assessment: 7**

The question paper shall consist of two parts as detailed below:–

Part A :- (Compulsory)

It shall consist of 6 very short answer type questions (Q. Nos. 1 to 6) from the entire syllabus and
the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. **6 x 1 = 6 Marks**

Part B:-

It shall consist of three sections (Section I, II & III). It shall consist of 9 questions
(Q. Nos. 7 to 15) from the entire syllabus. Each Section will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate
will attempt two questions from each section. Each question will be carrying four mark.
6 x 4 = 24 Marks

SECTION-I

I. Coordination Compounds **10 Hrs.**

Werner's coordination theory and its experimental verification, effective atomic number concept,
chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

II. Non-aqueous Solvents **5 Hrs.**

Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH3 and liquid SO2.

SECTION-II

III. Oxidation and Reduction **8 Hrs.**

Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, Latimer and Pourbaix diagrams.

IV. Chemistry of Lanthanide Elements **7 Hrs.**

Electronic structure, oxidation states and ionic radii and lanthanide contraction. Electronic absorption and magnetic properties of lanthanides.

SECTION-III

V. Chemistry of Actinides **5 Hrs.**

General features and chemistry of actinides, similarities between the later actinides and the later
lanthanides. Electronic and magnetic properties of actinides and their general comparison with the lanthanide elements.

VI. Bioinorganic Chemistry 10 Hrs.

Essential and trace elements in biological processes, metalloporphyrins and special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}.

B.Sc. (Semester-IV)

ORGANIC CHEMISTRY–III

Time: 3 Hrs. **Marks: 30**

45 Hrs (3 Hrs/week) **Internal Assessment: 7**

The question paper shall consist of two parts as detailed below:–

Part A :- (Compulsory)

It shall consist of 6 very short answer type questions (Q. Nos. 1 to 6) from the entire syllabus and the maximum length of each question may not exceed 1/3rd of the page. Each question will be carrying one mark. **6 x 1 = 6 Marks**

Part B:-

It shall consist of three sections (Section I, II & III). It shall consist of 9 questions (Q. Nos. 7 to 15) from the entire syllabus. Each Section will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying four mark. **6 x 4 = 24 Marks**

SECTION-I

I. Carboxylic Acids 8 Hrs.

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Reactions of carboxylic acids.Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides.Reduction of carboxylic acids. Mechanism of decarboxylation.

II. Carboxylic Acids Derivatives 7 Hrs

Structure and nomenclature of acid chlorides, esters, amides and acid anhydrides, Relative stability& reactivity of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reactions.

Mechanisms of esterification and hydrolysis (acidic and basic).

SECTION-II

III. Ethers and Epoxides **5 Hrs**

Nomenclature of ethers and methods of their formation, physical properties. Chemical reaction- cleavage and autoxidation, Ziesel's method. Synthesis of epoxides. Acid and basecatalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxiedes.

IV. Organic Compounds of Nitrogen **10 Hrs**

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes, Mechanisms of nucleophilc substitution in nitroarenes and their reduction in acidic, neutral and alkaline media.

Reactivity, Structure and nomenclature of amines, Methods of preparation of amines by Reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction and Hofmann bromamide reaction.Physical properties.Stereochemistry of amines.separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts.

SECTION-III

V. Organometallic Compounds **7 Hrs**

Organomagnesium Compounds: The Grignard reagentsformation, structure and chemical reactions.

Organolithium Compounds: Formation and chemical reactions.

Organosulphur Compounds: Nomenclature, structural features, Methods of formation and chemical reactions of thiols, sulphonic acids, sulphonamides.

VI. Heterocyclic Compounds **8 Hrs**

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

B.Sc. (Semester-IV)
CHEMISTRY PRACTICAL-III
Duration: 3½ hrs. Marks: 20

6 Period/Week

Qualitative Analysis

Detection of elements (N, S and halogens)

Detection of functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines,
amides, nitro and anilide) in simple organic compounds and preparing their derivatives.

Practical Examination
1) Detection of Elements 05
2) Detection of functional group and derivative preparation 18
3) Viva-Voce 04
4) Note Book 03

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (Semester-V)

INORGANIC CHEMISTRY–IV

Time: 3 Hrs Marks: 35

45 Hrs. (3 Hrs./week)

The question paper shall consist of two parts as detailed below:-

Part-A :- (Compulsory)

It shall consist of 8 very short answer type questions (Q. Nos. 1 to 8) from the entire syllabus and
the maximum length of each question may not exceed 1/3rd the page. Each question will be carrying one mark. **8 x 1 = 8 Marks**

Part-B :-

It shall consist of three sections (Section 1, II & III). It shall consist of 9 questions (Q. Nos. 9 to
17) from the entire syllabus. Each question will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying 4½ marks.
6 x 4½ = 27 Marks

SECTION-I

1. Metal-ligand Bonding in Transition Metal Complexes 10 Hrs

Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field
parameters.

2. Magnetic Properties of Transition Metal Complexes 5 Hrs

Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula. L-S coupling, correlation of μs and μeff values, orbital contribution to magnetic moments, application of magnetic moment data for characterization of 3d-metal complexes.

SECTION-II

3. Thermodynamic and Kinetic Aspects of Metal Complexes 5 Hrs

A brief outline of thermodynamic stability of metal complexes and factors affecting the stability,
substitution reactions of square planar complexes.

4. Electronic Spectra of Transition Metal Complexes 10 Hrs

Spectroscopic ground states for d1-d10 electronic configurations.
Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states.

SECTION-III

5. Organometallic Compounds: (15 Hrs)

Definition, nomenclature and classification of organometallic compounds. EAN rule, Preparation, properties, and applications of alkyls aryls of lithium and aluminium, Bonding in metal-ethylenic complexes, Mechanism of homogeneous hydrogenation reactions.

B.Sc. (Semester-V)

PHYSICAL CHEMISTRY–III

Time: 3 Hrs Marks: 35

45 Hrs. (3 Hrs./week)

The question paper shall consist of two parts as detailed below:-

Part-A :- (Compulsory)

It shall consist of 8 very short answer type questions (Q. Nos. 1 to 8) from the entire syllabus and
the maximum length of each question may not exceed 1/3rd the page. Each question will be carrying one mark. **8 X 1 = 8 marks**

Part-B :-

It shall consist of three sections (Section 1, II & III). It shall consist of 9 questions (Q. Nos. 9 to
17) from the entire syllabus. Each question will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying 4½ marks.
6 X 4½ = 27 Marks

SECTION-I

1. Electrochemistry-I 7 hrs

Electrical transport-conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law,
its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving
boundary method. Applications of conductivity measurements: determination of degree of dissociation, determination of Ka of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

2. Electrochemistry-II 8 hrs

Types of reversible electrodes-gas metal ion, metal ion, metal insolblue salt-anion and redox electrodes. Electrode reactions. Nernst equation, derivation of cell E.M.F. and Single electrode potential, standard hydrogen electrode, reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cellsreversible
and irreverisible cells, conventional representation of electrochemi cells.
EMF of a cell and its measurements.Computation of cell. EMF, Calculation of thermodynamic quantities of cell reactions (ΔG ΔH and K), polarization, over potential and hydrogen overvoltage. Concentration cells with and without transport, liquid junction potential, application

of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric
titrations.
Definition of pH and pKa, determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods. Buffers-mechanism of buffer action, Henderson-Hazel equation, Hydrolysis of salts. Corrosion-types, theories and methods of combating it.

SECTION-II

3. Nuclear Chemistry **15 Hrs**

Introduction: Radioactivity, Nuclear Structure, Size of Nucleus, Mass Defects and Binding Energy, Nuclear Stability, Nuclear Forces, Nuclear Spin and Moments of Nuclei, Nuclear Models, Nuclear Decay Processes, The Laws of Radioactive Decay, Soddy-Fajans Group Displacement Law, Rate of Nuclear Decay and Half Life Time (Kinetics of Radioactive Decay),
Induced Nuclear Reactions, Types of Nuclear Processes, High Energy Nuclear Reactions, Nuclear Reaction Cross-Section, Artificial radioactivity, Detection and Measurement of Radioactivity, Nuclear Fission, Nuclear Fusion, Applications of Radioactivity.

SECTION-III

4. Spectroscopy **15 Hrs**

Introduction: Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

5. Rotational Spectrum

Diatomic molecules. Energy levels of a rigid rotor (semiclassical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.

6. Vibrational Spectrum

Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational
spectrum, intensity, determination of force constant and qualitative relation of force constant and
bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.
Raman Spectrum: Concept of polarizability, pure rotational and pure vibrational Raman spectra
of diatomic molecules, selection rules.

7. Electronic Spectrum

Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle.
Qualitative description of s, p, and n M.O., their energy levels and the respective transitions.

B.Sc. (Semester-V)
CHEMISTRY PRACTICAL-V

Duration: 3½ Hrs. Marks: 30

6 Period/week

(I) Synthesis and Analysis
(a) Preparation of Sodium trioxalatoferrate (III)
(b) Preparation of Ni-DMG Complex
(c) Preparation of Copper tetrammine complex
(d) Preparation of cis-bisoxalatodiaquachromate (III) ion

(II) Physical Chemistry

(a) Conductometric Titrations
(i) Determine the end point of the following titrations by the conductometric methods.
Strong acid-Strong base
Strong acid-Weak base
Weak acid-Strong base
Weak acid-Weak base
(ii) Determine the composition of a mixture of acetic acid and the hydrochloric acid by conductometric titration.
(b) (i) Molecular Weight Determination of acetanilide, napthalane, using camphor as solvent **(Rast's methods).**
(ii) To determine the molecular weight of a polymer by viscosity measurements.
(c) Adsorption (i) To study the adsorption of acetic acid oxalic/acid from aqueous solutions by
charcoal.
(d) Phase Equilibria to determine the distribution coefficient of iodine between CCI4 and water.
(e) Refractometry
(i) Determination of refractive index of a liquid by Abbe refractometer, and hence the specific and molar refraction.
(ii) To determine the composition of unknown mixture of two liquids by refractive index measurements.

Practical Examination
1) Inorganic Synthesis 10
2) Physical experiment 13
3) Viva- Voce 04

4) Note Book 03

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (Semester-VI)

ORGANIC CHEMISTRY-IV

Time: 3 Hrs Marks: 35

45 Hrs. (3 Hrs./week)

The question paper shall consist of two parts as detailed below:-

Part–A :- (Compulsory)

It shall consist of 8 very short answer type questions (Q. Nos. 1 to 8) from the entire syllabus and
the maximum length of each question may not exceed 1/3rd the page. Each question will be carrying one mark. **8 X 1 = 8 Marks**

Part–B :-

It shall consist of three sections (Section 1, II & III). It shall consist of 9 questions (Q. Nos. 9 to
17) from the entire syllabus. Each question will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying 4½ marks.
6X 4½ = 27 Marks

SECTION-I

1. Spectroscopy **15 Hrs**

Nuclear Magnetic Resonance (NMR) spectroscopy.
Proton Magnetic Resonance (1H NMR) spectroscopy,
nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and
coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules
such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.

2. Electromagnetic Spectrum: Absorption Spectroscopy

Ultraviolet (U.V.) absorption spectroscopy introduction- (Beer-Lambert law), molar absorptivity,
analysis of UVspectra, types of electronic transitions effect of conjugation. Concept of chromophores and auxochrome, Bathochrome, hypsochrome, hyperchrome, hypochromic shifts-
UV spectra of conjugated compounds, Infrared (IR) Absorption spectroscopy-introduction, Hooke's law, Selection rules, intensity and IR bands, measurement of IR spectrum time characteristic absorption of various fundamental band interpretation of IR spectra of simple organic compounds.

SECTION-II

3. Problems based on spectroscopy (4 Hrs.)

Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and
PMR spectroscopic techniques.

4. Organosulphur Compounds (3 Hrs.)

Nomenclature, structural features, Methods of formation and chemical reactions of thiols,

thioethers, sulphonic acids, sulphonamides and sulphaguanidine.

5. Synthetic Polymers (4 Hrs.)

Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers.

Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.

6. Organic Synthesis *via* Enolates (4 Hrs.)

Acidity of α -hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethylacetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1,3-dithianes. Alkylation and acylation of enamines.

SECTION-III

7. Carbohydrates (8 Hrs.)

Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides.Erythro and threo diastereomers. Conversion of glucose into
mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose. Mechanism of mutarotation.

Structures of ribose and deoxyribose

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and
cellulose) without involving structure determination.

8. Amino Acids, Peptides, Proteins and Nucleic Acids (7 Hrs.)

Classification, structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α -amino acids.

Structure and nomenclature of peptides and proteins.Classification of proteins. Peptide structure
determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis,
solid-phase peptide synthesis. Structures of peptides and proteins.Levels of protein structure. Protein denaturation/renaturation.

Nucleic acids : Introduction. Constituents of nucleic acids.Ribonucleosides and ribonucleotides.

The double helical structure of DNA.

B.Sc. (Semester-VI)
PHYSICAL CHEMISTRY–IV

Time: 3 Hrs Marks: 35

45 Hrs. (3 Hrs./week)

The question paper shall consist of two parts as detailed below:-
Part–A :- (Compulsory)
It shall consist of 8 very short answer type questions (Q. Nos. 1 to 8) from the entire syllabus and
the maximum length of each question may not exceed 1/3rd the page. Each question will be carrying one mark. **8 X 1 = 8 Marks**
Part–B :-
It shall consist of three sections (Section 1, II & III). It shall consist of 9 questions (Q. Nos. 9 to
17) from the entire syllabus. Each question will consist of 3 questions from each Unit of syllabus. The maximum length of each question may not exceed 5 pages. The candidate will attempt two questions from each section. Each question will be carrying 4½ marks.
6 X 4½ = 27 Marks

SECTION-I

1. Quantum Mechanics-I **15 hrs**
Black-body radiation, Planck's radiation law, Photoelectric effect, heat capacity of solids, Bohr's
model of hydrogen atom (no derivation) and its defects, Compton effect.
de Broglie hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of
the wave function, postulates of quantum mechanics, particle in a one dimensional box, quantization of energy levels, extension to two and three dimensional boxes, degeneracy.

SECTION-II

2. Quantum Mechanics-II **15 hrs**
Simple harmonic oscillator model of vibrational motion, setting up Schrodinger equation and discussion of solution and wave functions. Rigid rotator model of rotation of diatomic molecules
transformation to spherical polar coordinates spherical harmonics and their discussion.
Qualitative investigation H-atom, setting up Schrodinger equation, radial and angular part, radial
distribution functions of 1s, 2s, 2p, 3s, 3p and 3d.

SECTION-III

3. Solid State (8 Hrs.)
Definition of space lattice and unit cell, Law of crystallography- (i) Law of constancy of

interfacial angles, (ii) Law of rationality of indices, (iii) Symmetry elements in crystals.
X-ray diffraction by crystals.Derivation of Bragg's Law in Reciprocal space. Determination of crystal structure of NaCl, KCl by use of Powder method; Laue's method.

4. Photochemistry (7 Hrs.)
Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus–Drapper law, Stark–Einstein law, Jablonski diagram depicting
various processes occurring in the excited state, qualitative description of flourescence, phosphorescence, non–radiative processes (internal conversion, intersystem crossing), quantum
yield, photosensitized reactions–energy transfer processes (simple examples).

B.Sc. (Semester-VI)
CHEMISTRY PRACTICAL-VI

Duration 3½ Hrs. 6 Period/weekM. Marks: 30

(I) Organic Chemistry Laboratory Techniques
(a) Column Chromatography
Separation of o & p nitrophenol
Separation of Leaf pigments from Spinnach leaves
Separation of o & p nitro aniline
Separation of dyes.

(b) Synthesis of Organic Compounds
Preparation of p-nitroacetanilide
Preparation of p-bromoacetanilide
Green Chemistry Experiment: Preparation of benzilic acid from Benzyl-using greenapproach.
Preparation of Methyl Orange, Methyl Red
Preparation of benzilic acid from benzyl-using green approach

Practical Examination
1) Column Chromatography 07
2) Organic Synthesis 16
3) Viva-Voce 04
4) Note Book 03

Books Suggested (Theory Courses)

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.
2. Concise Inorganic Chemistry, J.D. Lee, ELBS.
3. Concepts of Models of Inorganic Chemistry, B. Douglas, D. McDaniel and J. Alexander, John Wiley.
4. Inorganic Chemistry, D.E. Shriver, P.W. Alkins and C.H. Langford, Oxford.
5. Inorganic Chemistry, W.W. Porterfield Addison-Wesley.
6. Inorganic Chemistry, A.G. Sharpe, ELBS.
7. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, Prentice Hall.
8. Organic Chemistry, Morrison and Boyd, Prentice-Hall.
9. Organic Chemistry, L.G. Wade Jr. Prentice-Hall.
10. Fundamentals of Organic Chemistry, Solomons, John Wiley.
11. Organic Chemistry Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
12. Organic Chemistry, F.A. Carey, McGraw-Hill, Inc.
13. Introduction to Organic Chemistry, Sireitwieser, Heathcock and Kosover, Macmilan.
14. Physical Chemistry, G.M. Barrow, International Student Edition, McGraw Hill.
15. Basic Programming with Application, V.K. Jain, Tata McGraw Hill.
16. Computers and Common Sense, R. Hunt and Shelly, Prentice Hall.
17. University General Chemistry, C.N.R. Rao, Macmillan.
18. Physical Chemistry R.A. Alberty, Wiley Eastern Ltd.
19. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
20. Physical Chemistry Through Problems, S.K. Dogra and S. Dogra, Willey Eastern Ltd.

Books Suggested (Laboratory Courses)

1. Vogel's Qualitative Inorganic Analysis, revised, Svehla, Orient Longman.
2. Vogel's Textbook of Quantitative Inorganic Analysis (revised), J. Bassett, R.C. Denney, G.H. Jeffery and J. Mandham, ELBS.
3. Standard Methods of Chemical. Analysis, W.W. Scott: The Technical Press.
4. Experimental Inorganic Chemistry, W.G. Palmer, Cambridge.
5. Handbook of preparative Inorganic Chemistry, Vol. I & II, Brauer, Academic Press.
6. Inorganic Synthesis, McGraw Hill.
7. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
8. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
9. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
10. Experiments in General Chemistry, C.N.R. Rao and U.C. Aggarwal, East-West Press.
11. Experiments in Physical Chemistry, R.C. Das and B. Behra, Tata McGraw Hill.
12. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.
13. Advanced Experimental Chemistry, Vol. I, Physical, J.N. Guru and R. Kapoor, S. Chand &
Co.
14. Selected Experiments in Physical Chemistry, N.G. Mukherjee, J.N. Ghosh & Sons.
15. Experiments Physical Chemistry, J.C. Ghosh, Bharati Bhavan.

M.Sc. (Hons.) Chemistry (Semester-I)

CH401: Inorganic Chemistry-I

Ligand Field and Group Theory

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

45 hrs. **Time: 3 Hrs.**

Max. Marks: 40+10(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks**.**

UNIT-I

1. Group theory and its applications-I **11 Hrs**

Symmetry, symmetry elements and operations, Determination of point groups(flow chart), Order and class of point group, Reducible and irreducible representations(H_2O and BF_3).

Multiplication tables and derivation of character tables for C_{2V}, C_{3V} and cyclic group, Great orthogonality theorem, Mullikens notations.

UNIT-II

2. Group theory and its applications-II **11 Hrs**

Crystallographic Symmetry, Sub groups, determination of symmetry of atomic orbitals under different point groups. Hybridisation of atomic orbitals: sp, sp^2,sp^3, dsp^2, sp^3d and d^2sp^3 and group theory, Matric representation of symmetry operations, group theory and CFT.

Separation of d-orbitals under the influence of T_d,square planar, O_h and trigonalbipyramid symmetry, Vibrational modes in non-linear molecules, representation of vibrational modes in H_2O, NH_3 and BF_3. Group theory and linear molecules.

UNIT-III

3. Ligand Fields-I

11Hrs

Concept and scope of ligand fields, d and other orbitals, Qualitative determination of ligand field effects, the physical properties affected by LF, Ionic model of coordination compounds, Spin-orbit coupling, free ion in weak CF, Effect of cubic field on S,P,D,F,G,H,I terms.

Heat of ligation and CFSE, Standard electrode potential and CFSE, Cation distribution in lattice, spinels, interionic separation and CFSE and chemical stability.

4. Ligand Fields-2

12Hrs

Free ion in medium and strong fields. Transition from weak to strong fields, Correlation and Tanabe Sugano diagrams for d^2 to d^9(O_h and T_d), Elementary MOT, Bonding in octahedral and tetrahedral complexes.

Qualitative calculations of 10 Dq. Electronic spectra of complexes, Selection rules and band widths and factors, Jahn Teller effect.Spectra of $[M(H_2O)_6]^{+2}$.

Spectra of spin free and paired complexes, distorted O_h and T_d complexes, Spectrochemical and Nephelauxetic series and CT spectra.

Books Recommended:

1) Chemical applications of Group theory by F.A. Cotton.
2) Introduction to Ligand fields by B.N. Figgis.
3) Group theory by Raman.
4) Group theory in Chemistry by Gopinathan and Ramakrishnan.

M.Sc. (Hons.) Chemistry (Semester-I)

CH402: Organic Synthesis-I

Reaction Mechanism-Substitution Reactions

45 hrs. **Time: 3 Hrs.**

Max. Marks: 40+10(Internal Assesment)

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.
II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.
III. All questions carry equal marks.

UNIT-I

1. Reaction Mechanism: Structure and Reactivity **10**

Hrs

Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle.Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.Hard and soft acids and bases.

Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes.

Effect of structure on reactivity- resonance and field effects, steric effect, quantitative treatment.

The Hammett equation and linear free energy relationship, substituent and reaction constants.Taft equation.

UNIT-II

2.Stereochemistry : **7**

Hrs

Elements of symmetry, chirality, molecules with more than one chiral center.Threo and erythro isomers, methods of resolution, optical purity.

Prochirality – enantiotopic and diastereotopic atoms, groups and faces.

Stereospecific and stereoselective synthesis.Asymmetric synthesis.Optical activity in absence of chiral carbon (Biphenyls, Allenes, Spiranes).Chirality due to helical shape.

3. Aliphatic Electrophilic Substitutions **5**

Hrs

Bimolecular mechanisms- S_E2 and S_Ei: The S_E1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity, Hell-Volard-Zelinskyreactin ,

UNIT-III

4. Aliphatic Nucleophilic Substitutions **8**

Hrs

The S_N2, S_N1, missed S_N1 and S_N2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance.

Classical and nonclassicalcarbocations, phenonium ions, norbornyl system, common carbocation rearrangements.Application of NMR spectroscopy in the detection of carbocations. The $S_Ni$mechanisum,

Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium,

Phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity. Gabriel synthesis

5. Aromatic Nucleophilic Substitution **5**

Hrs

The S_NAr, S_N1, benzyne an SR_N1 mechanisms, Reactivity-effect of substrate structure, leaving group and attacking nucleophile.

The von Richter, Sommelet-Hauser, and Smiles rearrangements.

UNIT-IV

6. Aromatic electrophilic substitution **5**

Hrs

The arenium ion mechanism, orientation and reactivity in mono substitution and disubstituted aromatics, energy profile diagram, the *ortho*/*para* ratio, ipso attack, orientation in other ring systems, quantitative treatment of reactivity in substrates and electrophiles.

Diazo coupling, Vilsmeir reaction, Gatterman-Koch reaction, Bechmann reaction, Hoben-Hoesch reaction.

7. Free Radical Reactions **5**

Hrs

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance.Reactivity for aliphatic and aromatic substrates at a bridgehead.Reactvity in the attacking radicals.The effect of solvents on reactivity.

Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, autooxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

Books Recommended:

1. Stereochemistry - Eliel
2. Advanced Organic Chemistry – Jerry March.
3. Advanced Organic Chemistry, F. A. Carey, R. J. Sundberg, Volume I and II
4. Highlights of Organic Chemistry, W.J. L. Nobel; An Advanced Text Book.
5. Stereochemistry conformation and Mechanism – P. S. Kalsi

M.Sc. (Hons.) Chemistry (Semester-I)
CH403: Physical Chemistry
Thermodynamics

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

45 hrs. **Time: 3 Hrs.**

Max. Marks: 40+10(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

UNIT-I

1.Classical Thermodynamics-I **11 Hrs**

Brief resume of concepts of thermodynamics, Helmholtz and Gibb's free energy, chemical potential and entropy.Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances.Determination of these quantities.Concept of fugacity and determination of fugacity.

UNIT-II

2.Classical Thermodynamics-II **11 Hrs**

Non-ideal systems: Excess functions for non-ideal solutions. Activity, activity coefficients, Debye-Huckel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficients, ionic strength.

UNIT-III

3. Statistical Thermodynamics: 13Hrs

Thermodynamic probability, Most probable distribution, Stirling approximation, Maxwell-Boltzmann distribution law, Entropy and probability, Ensemble averaging, postulates of ensemble averaging. Types of ensemble systems, Lagrange's method of undetermined multipliers.

Partition functions: Translational, rotational, vibrational and electronic partition function, calculation of thermodynamic properties in terms of partition functions. Application of partition functions in the determination of equilibrium constants and heat capacity behavior of solids-chemical equilibria.

Types of statistics: Fermi-Dirac statistics-distribution laws, Bose-Einstein statistics-distribution law and application to helium.

UNIT-IV

4. Non Equilibrium Thermodynamics: 10 Hrs

Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes: heat flow, chemical reactions. transformations of generalized fluxes and forces, non-equilibrium stationary states, phenomenological equations, microscopic reversibility, irreversible thermodynamics for biological systems, coupled reactions.

Books recommended:

1. S. Glasstone: Thermodynamics for Chemists
2. P.W. Atkins: Physical Chemistry
3. S.H. Maron& C.F. Prutton: Principles of Physical Chemistry
4. Introduction to the Thermodynamics of Biological Processes by D. Jou& J. E. LLebot.
5. Pitts: Non equilibrium thermodynamics
6. I Prigogine: Introduction to thermodynamics of irreversible processes

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-I)

CH404: Spectroscopy-A

Techniques for Structure Elucidation of Organic Compounds

60 hrs. **Time: 3 Hrs.**

Max. Marks: 60+15(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and
the Compulsory question.

III. All questions carry equal marks**.**

UNIT-I

1. General Features of Spectroscopy: 3 Hrs

Units and conversion factors.Introduction to spectroscopy, Nature of radiation. Energies corresponding to various kinds of radiation, Experimental techniques, intensities of spectral lines, Selection rules and transition moments, Line widths, Broadening.

2. Nuclear Magnetic Resonance Spectroscopy-I 12 Hrs

PMR: Natural abundance of ^{13}C, ^{19}F and ^{31}P nuclei; The spinning nucleus, effect of external magnetic field, precessional motion and frequency, Energy transitions, Chemical shift and its measurements. Factors influencing chemical shift, anisotropic effect; Integrals of protons, proton exchange, spin-spin coupling- splitting theory, one, two and three bond coupling, virtual, long range and allylic coupling, magnitude of coupling constant; factors affecting the coupling constant, Chemical and magnetic equivalence, First and second order spectra, A_2, AB, AX, AB_2, AX_2, A_2B_2 and A_2X_2 spin systems.

UNIT-II

3. Nuclear Magnetic Resonance Spectroscopy-2 13 Hrs

Simplification of complex spectra (solvent effect, field effect, double resonance and lanthanide shift reagents), CW and FT NMR, Relaxation processes, T1 and T2 measurements, Applications of PMR in structural elucidation of simple and complex compounds.^{13}C-NMR: Resolution and multiplicity of ^{13}C NMR, ^{1}H-decoupling, noise decoupling, broad band decoupling; Deuterium, fluorine and phosphorus coupling; NOE and origin of nuclear overhauser effect. off-resonance, proton decoupling.

Structural applications of ^{13}C-NMR., pulse sequences, pulse widths, spins and magnetization vectors, DEPT, INEPT.

Introduction to 2D-NMR, COSY, NOESY, HSQC spectra

UNIT-III

3. Mass Spectra: 8 Hrs Introduction, methods of ionization EI & CI, Brief description of LD, FAB, SIMS, FD etc., Ion analysis methods (in brief), isotope abundance, Metastable ions, general rules

predicting the fragmentation patterns. Nitrogen rule, determination of molecular ion peak, index of H deficiency, fragmentation patterns for aliphatic compounds, amines, aldehydes, Ketons, esters, amides, nitriles, carboxylic acids ethers, aromatic compounds etc.

4. UV and Visible Spectroscopy of organic molecules: 8 Hrs

Measurement techniques, Beer – Lambert's Law, molar extinction coefficient, oscillator strength and intensity of the electronic transition, Frank Condon Principle, Ground and first excited electronic states of diatomic molecules, relationship of potential energy curves to electronic spectra, Chromophores, auxochromes, blue shift, red shift, hypo and hyperchromic effect, n-σ^*,π-π^*, n-π^* transitions in organic molecules.

Woodward rules for conjugated dienesand , - unsaturated carbonyl groups, extended conjugation and aromatic sterically hindered systems, Quantitative applications.

UNIT-IV

5. Infrared Spectroscopy 8 Hrs

Vibrational Energy Levels, Selection Rules, Force Constant, Fundamental Vibration requencies, Factors influencing Vibrational Frequencies (Vibrational Coupling, Hydrogen Bonding, lectronic effect, Bond Angles, Field Effect). Sampling Techniques, Absorption of Common functional Groups, Interpretation, Finger print Regions.

Applications in Organic Chemistry

(a) Determining purity and quantitative analysis.
(b) Studying reaction kinetics.
(c) Determining purity and quantitative analysis.
(d) Studying hydrogen bonding.
(e) Studying molecular geometry & conformational analysis.
(f) Studying reactive species

6. Solution of Structural Problems by Combined Use of the following Spectroscopic Techniques

8Hrs

(a) Electronic spectra
(b) Vibrational spectroscopy
(c) NMR (1H and 13C) spectroscopy
(d) Mass Spectroscopy

Books Recommended:

1. Pavia, Lampman&Kriz, Introduction to Spectroscopy.
2. C.N Banwell "Fundamentals of Molecular Spectroscopy".
3. R. M. Silverstein, G.C.Bassler, T.C. Morrill, "Spectrometic Identification of Organic Compounds.
4. W. Kemp, "Organic Spectroscopy".
5. D.H. Williams, I. Fleming, "Spectroscopic Methods in Organic Chemistry".
6. D.H. Williams, I. Fleming, "Spectroscopic Problems in Organic Chemistry", 1967.
7. R.C. Banks, E.R. Matjeka, G. Mercer, "Introductory Problems in Spectroscopy", 1980.
8. G.M. Barrow "Introduction to Molecular Spectroscopy".

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-I)

CH405/406: Computer for Chemists

75 hrs. **Time: 3 Hrs.**

Max. Marks: 60+15(Internal Assesment)

Theory Marks: 40+10(Internal Assesment)

Practical Marks: 20+5(Internal Assesment)

Instructions for paper setters and candidates

The paper will consist of 45 Hours of teaching in class room and 15 sessions of 2 hours of practical training on computers. The theory will be of 50 marks and practical would be of 25 marks. The students would prepare a record of the programs written by them along with the outputs.

1. Computer Programming in C language 30 Hrs

Principles of programming, algorithms and flowcharts.Elementary programming, a typical C program, printf function. Introduction of declarations, assignments and variables: concept of an integer, concept of a variable, rules for naming variables, assignment statement, arithmetic operators. Integer arithmetic expressions, truncation effects, relative priority of arithmetic operators, use of parenthesis, modulus operator. Floating point numbers, scientific notation, converting integers to floating point and vice versa , coercion and cast operator, type char.

Decision making in C, scan f function, relational operators, logical operators, if statement, if else statement, nesting of if statement.

The while loop, do while loop, for loop, nesting of for loop.

Type char and ASCII code, character strings and how to print them, octal and hexadecimal notation.

User defined functions, returning value from a function, functions with more than one parameters.

Arrays, declaring an array, initializing an array, break statement, strings and character arrays, sorting an array, finding maximum and minimum in an array, multidimensional arrays.Input and output.

2. Computer programs in Chemistry 15Hrs(Theory) + 30Hrs(Practical)

(These are also be done in the practical class):

Development of small computer codes involving simple formulae in chemistry:

1. Calculation of mean, median, mode.
2. Solution of a quardratic equation.
3. Calculation of linear regression.
4. Calculation of curve linear regression.
5. Calculation of Bohr orbit from de Broglie Lambda for electron.
6. Calculation of wave number and frequency from value of wave length.
7. Calculation of van der Waals radii.
8. Radioactive decay.
9. Rate constant of a 1st order reaction, 2nd order reaction.
10. Determination

11. Calculation of lattice energy using Born Lande equation.
12. Addition, multiplication and solution of inverse of 3 X 3 matrix.
13. Calculation of average molecular weight of a polymer containing n1 molecules of molecular
weight m1, n2 molecules of molecular weight M2 and so on.
14. Program for calculation of molecular weight of organic compound containing C, H, N, O and S.
15. Calculation of reduced mass of diatomic molecule.
16. Calculate the RMS and most probable velocity of a gas.
17. Calculate the ionic mobility from ionic conductance values.
18. Determine the thermodynamic parameters for isothermal expansion of monoatomic ideal gas.
19. Calculation of value of g- factor from value of J and S.
20. Calculate the bond length and bond angles using crystal structure data.

Recommended Books:

1. K.V. Raman, Computers in Chemistry, Tata McGraw Hill.
2. Mullish Cooper, The spirit of c, An Introduction to Modern Programming.

M.Sc. (Hons.) Chemistry (Semester-I)
CH407: Inorganic Chemistry Practical
Quantitative analysis

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

Max. Marks: 60+15(Internal Assesment) **Labs Hrs.: 60**

I. Oxidation-Reduction Titrations

1. Standardization with sodium oxalate of $KMnO_4$ and determination of Ca^{2+} ion.
2. Standardization of ceric sulphate with Mohr's salt and determination of Cu^{2+}, NO_3^{-1} and $C_2O_4^{-2}$ ions.
3. Standardization of $K_2Cr_2O_7$ with Fe^{2+} and determination of Fe^{3+} (Ferric alum)
4. Standardization of hypo solution with potassium iodate / $K_2Cr_2O_7$ and determination of available Cl_2 in bleaching powder, Sb^{3+} and Cu^{2+}.
5. Determination of hydrazine with KIO_3 titration.

II. Precipitation Titrations

1. $AgNO_3$ standardization by Mohr's method by using adsorption indicator.
2. Volhard's method for Cl^- determination.
3. Determination of ammonium / potassium thiocyanate.

III. Complexometric Titrations

1. Determination of Cu^{2+} and Ni^{2+} by using masking reagent by EDTA titration.
2. Determination of Ni^{2+} (back titration).
3. Determination of Ca^{2+} (by substitution method).

IV. Gravimetric Analysis

1. Determination of Ba^{2+} as its chromate.
2. Estimation of lead as its lead molybdate.
3. Estimation of chromium (III) as its lead chromate.
4. Estimation of Cu^{2+} using Ammonium/ Sodium thiocyanate.

Book: Vogel's book on Inorganic Quantitative Analysis.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-I)

CH408: Physical Chemistry Practical

Max. Marks: 60+15(Internal Assesment) **Labs Hrs.: 60**

1. To determine the strength of given acid by *p*H metrically.
2. To determine dissociation constant of given acid *p*H metrically
3. Titration of weak acid conductometrically
4. Titration of strong acid conductometrically
5. To determine dissociation constant of given acid conductometrically
6. Determine the dissociation constant of acetic acid in DMSO, DMF, dioxane by titrating it with KOH.
7. Determine the activity coefficient of an electrolyte at different molalities by e.m.f. measurements.
8. Compare the cleansing powers of samples of two detergents from surface tension measurements.
9. Determine the specific refraction, molar refraction and atomic parachor with the help of Abbe'srefractometer.
10. To study the distribution of benzoic acid between benzene and water.
11. Determine the equilibrium constant of reaction K_1+ +l_2→ Kl_3 by distribution law and hence

    Findthe value of GO of the above reaction
12. Compare the relative strength of CH_3COOH and $ClCH_2COOH$ from conductance measurements.
13. Determine the solubility (g/litre) of sparingly soluble lead sulphate from conductance measurements.
14. Titrate a given mixture of HCl and CH_3COOH against NaOH solution conductometrically..
15. Compare the relative strength of:

    i) HCl

    ii) H_2SO_4

by following the kinetics of inversion of cane sugar polarimetrically.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-II)

CH409: Inorganic Chemistry-II

Reaction Mechanism, Organometallics and Catalysis

60 hrs. **Time: 3 Hrs.**

Max. Marks: 60+15(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks**.**

UNIT-I

15Hrs

Energy,polarity and reactivity of M-C bond,stability and lability of main group organometallics and their preparation.

Li organometallics: Structure,bonding and reactions. Carbolithitian. Organometallics of group 2 and 12:

Organometallics of Be and Mg: Preparation, mechanism of formation and constitution,Grignard reagent in solution and reactions.

Organometallics of Zn,Cd,Hg: Preparation,structure and properties.Technical applications of tris(alkyl)aluminium compounds.

Organometallics of transition elements:EAN rule and MOT relationship in O_h sigma and O_h sigma and □ bonding.The particular case of d^8 and d^{10} complexes.Sigma and □ donor/acceptor ligands.

UNIT-II

15Hrs

Olefin complexes: Preparation,structure and bonding.Alkyne and allyl complexes: Preparation,structure and reactions. Complexes of cyclic π parameter C_nH_n; Sandwich complexes, Half sandwich complexes, Multidecker sandwich complexes,Tilted sandwich structure, complexes with more than two C_nH_n ligand. C_4H_4 and $C_5H_5^-$

Organometallics: Preparation,structure,reactions and bonding. MOT for ferrocene and bis(benzene)chromium(0) : preparation and reactions. Cycloheptatrienyl and COT complexes: preaparation and structure and bonding.

Catalytic reactions and 16/18 electron rule,alkene metathesis,Chauvin mechanism, Olefin polymerization,Ziggler-Natta polymerization,Cossee mechanism,hydrogenation of alkenes, Wilkinson's catalyst,Fischer-Tropsch reactions, water gas shift reactions,Monsanto acetic acid process,hydrocyantion,Reppecarbonylation, hydroformylation of unsaturated compounds.

UNIT-III

15Hrs

Reductive carbonylation of alcohols and other compounds,carbonylation reactions: methanol and methyl acetate,adipic ester and other compounds,synthesis and carbonylation reactions,decarbonylation reaction,catalytic addition of molecules to carbon-carbon multiple bonds,homogeneous hydrogenation,hydrocyanation and hydrosilation of unsaturated compounds,polymerization.Oligomerisation and metathesis of alkene and alkynes.Cluster compounds in catalysis,supported homogeneous and phase transfer catalysis, oxidation reactions,oxidativecarbonylation. Pdcatalysed oxidation of ethylene,acrylonitrile synthesis,oxygen transfer from peroxo and oxo species and NO_2 groups.

Ligand replacement reaction,Labile and Inert complexes and CFT, water exchange rates,formation of complexes from aqueous ions,Anation,Aquation and acid-base hydrolysis,Mechanism of acid hydrolysis when inert ligand is a π donor/acceptor and cis to leaving group,attack on ligands.

Substitution in square palanar complexes, factors,trans effect,its theories and applications,Kurnakov test.

UNIT-IV

15Hrs

Metal carbonyl reactions,reactions of binuclear carbonyls,associative reactions,species with 17 electrons,electron transfer processes,orbital occupation effects on substituition reactions of octahedral complexes.Synthesis of coordination compounds by substituitional reactions,synthetic chemistry of some cobalt and platanium complexes.Marcus theory and applications,electron transfer reactions,doubly bridged inner sphere,electron transfer,other electron transfer,two electron transfer reactions,complimentary and non-complimentary reactions.Ligand exchange *via* electron exchange, Stereochemical non-rigidity of complexes and oraganometalics and NMR,trigonal and trigonalbipyramid molecules,system with coordination number 6 and more.Isomerisation and racemisation of tris chelates complexes and mechanism.Metal carbonyl scrambling,Rotation within coordination sphere.

Recommended Books:

1) F.A.Cotton and I.G. Wilkinson,Advanced Inorganic Chemistry,5thed.New YORK 1988.
2) Organometallics by Salzer.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-II)

CH410: Organic Synthesis-II

Reaction Mechanism- Addition, Elimination and Rearrangement Reactions

45 hrs. **Time: 3 Hrs**

Max. Marks: 40+10(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

UNIT-I

1.Addition to Carbon-carbon and Carbon-Hetero Multiple Bonds-I 12 Hrs

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring.Hydrogenation of double and triple bonds, hydrogenation of aromatic rings.Hydroboration.Michael reaction.Sharpless asymmetric epoxidation. Addition of Grignard reagents, organozinc, organolithium and Gillman reagents to carbonyl and unsaturated carbonyl compounds. Use of other organometallic reagents in addition reactions. Wittig reaction,

UNIT-II

2.Addition to Carbon-carbon and Carbon-Hetero Multiple Bonds-II 3Hrs

Mechanism of condensation reactions involving enolates – Aldol,.Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

Hydrolysis of esters and amides, ammonolysis of esters.

3. Rearrangements: 8 Hrs

General mechanistic consideration – nature of migration, migratory aptitude, memoryeffects. A detailed study of the following rearrangements, Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber,Beckmann, Hofman, Curtius, Schmidt, Shapiro reaction, Fries rearrangement.

UNIT-III

4. Elimination Reactions: 5 Hrs

The E_2, E_1 and E_1cB mechanisms and their spectrum.Orientation of the double bond. Reactivity – effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

5. Oxidation Reactions: 7 Hrs

Indtoduction.Different oxidative processes. Hydrocarbons- alkenes, aromatic rings, saturated C-H groups)activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxyalic acids.Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzenediacetate and thallium (III) nitrate, DDQ, PCC, CAN, selenium dioxide, peroxyacids, DCC. Oxidation reactions with special emphasis on Baeyer-villeger reaction, Cannizarro oxidation-reduction reaction,

UNIT-IV

6. Reduction Reactions: 10 Hrs

Introduction. Different reductive processes, Hydrocarbons- alkanes, alkenes, alkynes and aromatic rings, Carbonyl compounds – aldehydes, ketones, acids, ester and nitriles. Epoxides, Nitro, nitroso, azo and oxime groups, Hydrogenolysis. Sodium borohydride, sodium cyanoborohydride, LAH, disobutylaluminium hydride, tin hydride, trialkyl tin hydride, trialkylsilanes, alkoxy substituted LAH, DIBAL, diborane, diisoamylborane, hexyl borane, 9-BBN, isopinocamphenyl and disiopinocamphenylborane. Reduction reactions with particular emphasis on Wolf-Kishner reduction, Clemensen reduction.

Recommended Books:

1. Organic Reaction Mechanism by Jerry March, John Wiley Ed. 5, 2002.
2. Advanced Organic Chemistry by Francis Carey, Vol A and vol B

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-II)

CH411: Physical Chemistry-II

Quantum Chemistry

45 hrs. **Time: 3 Hrs**

Max. Marks: 40+10(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.
II. The students are required to attempt FIVE questions in all, ONE question from each unit and
the Compulsory question.
III. All questions carry equal marks**.**

UNIT-I

1. Quantum Theory: Introduction and Principles **12 Hrs**

Black body radiations, planck's radiation law, photoelectric effect, Compton effect, De-Broglie hypothesis, the Heisenberg's uncertainty principle, Rydberg relation for explaining atomic spectrum of hydrogen. Bohr's Theory and its limitation solution of classical wave equation by separation of variables method.

UNIT-II

2. Quantum mechanical operators **5 Hrs**

Operators and observations, normal and orthogonal functions, hermitian and unitary operators, introduction to differentiation and integration, Eigen value equation. Hamiltonian operator, interpretation of wave function, postulates of quantum mechanics.

3. Applications of Quantum Postulates **7 Hrs**

Solution of particle in one and three dimensional box, degeneracy, the linear harmonic oscillator, rigid rotators, quantization of vibrational and rotational energy levels, hydrogen and hydrogen like atoms.

UNIT-III

3. Angular Momentum **5 Hrs**

Commutative laws, need of polar coordinates, transformation of Cartesian coordinate into polar coordinate, angular momentum of one particle system, orbital angular momentum, the ladder operator method for angular momentum, spin angular momentum and their relations

4. The Approximate Methods **6 Hrs**

Need for approximation methods, Perturbation and Variation methods and their application to Helium atom.

UNIT-IV

4. General Orbital Theory of Conjugated Systems 10 Hrs

Chemical bonding, linear combination of atomic orbital, overlap integral, coulomb's integral, bond order, charge density calculations for ethylene, allyl system, butadiene system, cyclo butadiene cyclopropenyl system.

Recommended Books:

1. Physical Chemistry, A Molecular Approach by MacQuarrie and Simon.
2. Quantum Chemistry, Ira N. Levine, Prentice Hall.
3. Quantum Chemistry, H. Eyring, Kimball and Walter.
4. Quantum Chemistry, Atkin.
5. Fundamentals of Quantum Chemistry, Anantharaman. R.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-II)

CH412: Spectroscopy-B

Techniques for Structure Elucidation of Inorganic Compounds

60 hrs. **Time: 3 Hrs**

Max. Marks: 60+15(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and

the Compulsory question.

III. All questions carry equal marks**.**

UNIT-I

1. Vibrational Spectroscopy 15 hrs

Theory of Infrared Absorption: Harmonic and anhormonic oscillators, absorptions of radiation by molecular vibrations, selection rules, force constant, frequency of vibrational transitions of HCl, vibrations in a polyatomic molecule, 3N-6 and 3N-5 rules, types of vibrations, overtones, combination and difference bands, examples of CO_2, SO_2, and H_2O, Fermi resonance, group vibrations.

Raman Spectroscopy: Introduction, selection rules, anisotropic polarizability, Stokes, anti-Stockes lines, vibrational Raman spectra of CO_2 and H_2O, polarised and depolarised Raman lines, rule of mutual exclusion, vibronic coupling.

Determination of I.R/Raman Active Modes: Significance of nomenclature: used to describe various vibrations, use of symmetry considerations to determining the number of active infrared and Raman lines (character tables to be provided in the Examination).

Sample handling. Factors affecting absorption frequencies.Interpretation and finger printing regions. Applications of Raman and I.R selection rules to the determination of Inorganic structure with special emphasis on:

i) Metal carbonyls
ii) NSF_3
iii) Geometrical isomerism – differentiation between Cis and trans $[Co(bipy)_2Cl_2]Cl$.
iv) Structures of CO_2, N_2O, H_2O, chlorocomplexes of mercury, cadmium and zinc, and octahedral complexes SiF_6^{2-}, PF_6^-, SF_6.
v) Changes in the spectra of donor molecules upon coordination with special emphasis on N, N-dimethylacetamide and DMSO with Fe^{3+}, Cr^{3+}, Zn^{2+}, Pd^{2+} and Pt^{2+} ions. I.R spectroscopy and modes of coordination of SO_4^{2-}, N_2, O_2, NO, CO_3^{2-}, NO_3^-.

UNIT-II

2. Pure Rotational Spectra 8 hrs

Classification of molecules according to their moment of inertia.Rotational spectra of diatomic molecules (rigid rotator), Intensities of spectral lines, isotopic substitution effects, non-rigid rotator, polyatomic linear and symmetric top molecules, Stark effect.

3. Nuclear Quadruple Resonance Spectroscopy 7 hrs

Introduction, Experimental considerations, fundamentals of NQR spectroscopy, origin of EFG, measurement of energy differences between two nuclear spin states, the asymmetry parameters, effects of magnetic field, crystal field. Interpretation of spectra, application of the technique to halogen compounds (Organic), group elements, transition metals. Double resonance technique.

UNIT-III

4. Photo Electron Spectroscopy 8 hrs

Introduction, excitation and ejection of electrons, electronic energy in atoms and molecules, core level PES, symmetry and molecular orbitals, molecular orbital diagrams of dinitrogen and dioxygen, their XPS spectra, Valence electron photoelectron spectroscopy, Franck Condon principle, dissociation, predissociation, change of shapes of molecules on excitation.

5. Mössbauer Spectroscopy 8hrs

Principle, experimental considerations, conditions of MB Spectra, the spectrum and its parameters, simple spin states (I ½, 3/2), higher spin states (I > 3/2), magnetic splitting significance of parameters obtained from spectra, quadruple splitting, additive model, interpretation of MB Spectra of ^{57}Fe, ^{119}Sn. Application to biological systems, surface study, and compounds of group elements.

UNIT-IV

6. Electron Spin Resonance Spectroscopy 14 hrs

Introduction, principle, brief instrumentation of spectrum, hyperfine splitting in isotropic systems involving more than one nucleus, ESR spectrum of benzene radical anion, methyl radical, CH_2OH, H_3CCH_2 radical, cyclopentadienyl, cycloheptatrienyl radical, pyrazine anion, pyrazine anion with ^{23}Na and ^{39}K counter ion and p-benzosemiquinone, DPPH, Naphthalene. Factors affecting magnitude of g values, zero field splitting, and Krammer's degeneracy. Qualitative survey of EPR spectra of first row transition metal ion complexes (d^1, d^2, d^3, low spin d^5, high spin d^6, d^7, d^9 system). Spectra of triplet states, rate of electron exchange, double resonance (ENDOR, ELDOR)

Books Recommended:

1) R. S. Drago, "Physical Methods in Chemistry". W.B Saunders Company.
2) C. N. Banwell, "Fundamentals of Molecular Spectroscopy".
3) R. V. Parish, "NMR, NQR, EPR & Mossbauer spectroscopy in Inorganic Chemistry". Ellis Horwood, London, 1990.
4) G. M. Barrow, "Introduction to Molecular Spectroscopy".
5) E. A. Ebsworth, S. Craddock and D. W. H. Rankin, "Structural methods in Inorganic Chemistry".Blackwell Scientific Publications (1991).
6) C. N. R. Rao and J. R. Ferraro, "Spectroscopy in Organic Chemistry, Vol. I". Academic Press (1971)
7) Walker and Straughan, "Spectroscopy, Vol I and III".

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-II)

CH413: Organic Synthesis-III

Supramolecular,Bio-organic Chemistry and Asymmetric Synthesis

45 hrs. **Time: 3 Hrs.**

Max. Marks: 40+10(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and
the Compulsory question.

III. All questions carry equal marks.

UNIT-I

1. Supramolecular Chemistry-I

(a) Concepts

2Hrs

Definition and Development of Supramolecular Chemistry, classification of Supramolecular Host-Guest compounds, Pre- organization and Complementarily, Receptors, Nature of Supramolecular interactions.

(b) Cation Binding Host

2Hrs

Crown ethers, Lariat ether and Podands, Cryptands, spherands, selectivity, Macro cyclic, Macrobicyclic and Template effects, soft ligands, calixarenes, carbon donor and π- acid ligands, siderophores.

(c)Binding of anions and neutral molecules

8Hrs

Biological anion receptors, concepts on anion host design, Fromcation to anion hosts- a simple change in pH, Guanidinium- based receptors, Neutral receptors, organometallic receptors, coordination interactions. Inorganic solid state clathrate compounds, solid state clathrates of organic hosts, intracavity complexes of neutral molecules, supramolecular chemistry of fullerenes.

UNIT-II

2. Supramolecular Chemistry-II

Crystal Engineering and Molecular Devices

5Hrs

Concepts, crystal structure prediction, Crystal Engineering with hydrogen bonds, weak hydrogen bonds, hydrogen bonds to metals and metal hydrides, π- π stacking, coordination polymers. Introduction, Supramolecular photochemistry, molecular electronic devices: Switches, wires and rectifiers, machines based on catenanes and rotaxanes.

3.Bio-organic Chemistry-I

Basic considerations.Proximity effects and molecular adaptation.

5Hrs

Introduction and historical prospective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and

classification, extraction and purification. Fischer's lock and key and koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-menten and lineweaver-Burk plots, reversible and irreversible inhibition.

UNIT-III

4.Bio-organic Chemistry-II

(a) Mechanism of Enzyme Action

3Hrs

Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion.Examples of some typical enzyme mechanisms for chymotrypsin, ribonucleases, lysozyme and carboxypeptidase A.

(b) Reaction Catalysed by Enzymes

6Hrs

Nucleophilic displacement on a phosphorus atom, multiple displacement reaction and the coupling of ATP cleavage to endergonic processes. Transfer of sulphates, addition and elimination reactions, enolic intermediates in isomerization reactions, β-cleavage and condensation, some isomerisation and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

(c) Co-Enzyme Chemistry

4Hrs

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological function of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, LIPOIC ACID, vitamin B12. Mechanisms of reactions catalysed by the above cofactors.

UNIT-IV

5. Asymmetric Synthesis

(a) General Aspects

2Hrs

Analytical methods for determination of enantiomeric purity – GC, HPLC and NMR.Naturalsources of chiral starting materials, classification and methods of formation of new chiralcompounds.

(b) Non-Enzymatic Approaches

4Hrs

Methods of asymmetric synthesis using naturally occurring chiral compounds, nucleophile andelectrophile bearing chiral auxillary, Diels-Alder cycloaddition and Claisen-coperearrangements.

Asymmetric carbon-carbon bond formation using alkylation, Michael reaction and addition tocarbonyl compounds. Cram's rule and Felkin-Ahn model.Asymmetric oxidation andreductions.

(c) Enzymatic Approaches

4Hrs

Enzymatic and Microbial methods in asymmetric synthesis.Use of different types of enzymeslipases, oxidases etc. in organic synthesis.

Recommended Books :

1. J.W Steed and J.L Atwood, Supramolecular chemistry, John Wiley & Sons, Ltd. New York.
2. Principles of Biochemistry By Lehninger

3. Principles of Biochemistry By Voet and Voet

M.Sc. (Hons.) Chemistry (Semester-II)

CH414(a): Mathematics for Chemists

For Non Medical Students

30 hrs. **Time: 2 Hrs** **Max. Marks: 20+05(Internal Assesment)**

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions of 4 marks from each unit and ONE compulsory question of short answer type of 4 marks covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and
the Compulsory question.

UNIT-I

1. Trignometry **7 Hrs**

Definition of sin, cos, tan, cot, sec, cosec functions with the help of unit circle, values of sin x cos x cos x for x = 0, n/6, n/3, n/2. Meaning of a trignometrical identity. The following identities (no need of derivation and proof. However, application has to be
emphasized).

$Cos^2x+sin^2x = 1$

Sin (x=2π)-Sin^2x/½ sin x

Cos (x-2π)Cos x

Cos(-x = cos x; sin(-x) = sin x

Sin(π-x) = sin x ; cos (π-x) = -cos x

Sin(π+x)= -xin x; (π+x) = -co x

Sin 2x = 2 sin x cos x

Cos 2x = 2 sin x cos x

Cos 2x = $2lcosx^{-1}$

Tan (x) = -sin x; cos x

Tan (x) = -tan x; tan(x/2 – x = cot x)

Tan (π-x) = -tan x

Tan 2x = 2 tan x/(1-tan^2x)

UNIT-II

2. Determinants and Matrices **5 Hrs**

Definition and expansion properties of determinants, product of two determinants of 3rdorder. Introduction to various terms Matrix, row, column, diagonal unit. Sub, square, equal matrices, null, symmetricular, order of, character of, transpose of, adjoint of, inverse of matrices.

Addition multiplication, diagonalization, similarity transformation of matrices, characteristic equation statement of CayleyHumilton theorem. Rank of matrix, condition of consistency of a system of linear equations. Eigen vectores and Eigen values using matrices.

UNIT-III

3. **Differential Calculus** **8 Hrs**

Differentiation of standard functions, theorems relating to the derivative of the sum, difference, product and quotient of functions, derivative of trigonometric functions, inverse trigonometric functions, logarithmic functions and exponential functions, differentiation of implict functions, logarithmic differentiation.

UNIT-IV

4. **Integral Calculus (10 Hrs.)**

Integration as an inverse of differentiation summation, area under a curve, indefinite integrals of standard forms, method of substitution, method of partial fractions, integration by parts, definite integrals, reduction formulae, definite integrals of limit of a sum and geometrical interpretation.

Books Recommended:

1. Santi Narayan – Differential Calculus.
2. Santi Narayan - Integral Calculus.
3. B.S. Grewal – Higher Engineering Mathematics.
4. Joseph B. Dence – Mathematical Techniques in Chemistry.
5. Margenau and Murphy, the Mathematics of Physics and Chemistry.
6. B.L. Moncha and H.R. Choudhary – A Text Book of Engineering Mathematics.

Department of Chemistry, Khalsa College, Amritsar
Academic Year:2015-16

For Medical Students

30 hrs. **Time: 2 Hrs**

Max. Marks: 20+05(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of TEN questions comprising THREE questions from each unit carrying 3 marks and ONE compulsory question of short answer type of 5marks covering the whole syllabi.
II. The students are required to attempt SIX questions in all, atleast ONE question from each unit and a Compulsory question.

UNIT-I

1. The Organisation of Life
10Hrs
Biologically important molecules: Carbohydrates, lipids, proteins and nucleic acids.
The life of cells – The cell theory, general characteristics of cells, difference between proaiyotic and eukaryotic cells, difference between plant and animal cells, cell organells.
Tissues, organs and organ systems: Animal tissues; epithelial tissues, connective tissues, muscle tissue, nervous tissue and neoplasias; plant tissue: maristematic tissue, permanent tissues.

UNIT-II

2. Genetics
10Hrs
The basic principle of heredity: Mendals law, monohybrid cross, dihybrid cross.
DNA – Double halix structure and replication.
Genes expression: Transcription and translation, genetic code.

UNIT-III

3. The Diversity of Life
10Hrs
The classification of Living things – Criteria of classification, Whittaker's systems of classification, their characteristics with are example of each.
Viruses, structure of Viruses.

Book Recommended:
1. Cord Biology - South Western Educational Publications, Texas, 2000.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-II)

CH415: Organic Chemistry Lab

Quantitative analysis and Multistep Synthesis

Max. Marks: 60+15(Internal Assesment) **Labs Hrs.: 60**

1. Quantitative Analysis

(a) Extraction of Organic Compounds from Natural Sources

1.Extraction of Caffeine from tea leaves
2. Isolation of casein from milk (try some typical colour reactions proteins).
3**.** Isolation of essential oils from Caraway seeds and orange peels – (S) – Carvone and (R) – Limonene

(b) Quantitative Analysis of Organic Compounds:

1. Estimation of phenol/aniline using bromate-bromide solution.
2. Estimation of reducing sugar by Fehling solution method.
3. To determine the saponification value of the given fat or oil sample.
4. To determine the iodine number of the given fat or oil sample.

2. Multistep Organic Synthesis

1. Synthesis of 2-chloro-4-bromoaniline from aniline (Bromination and chlorination)
3. Photochemical synthesis of benzpinacol and its pinacol rearrangement.
4. Synthesis of o-chlorobenzoic acid from phthalimide. Synthesis of acridone from o-chlorobenzoic acid. (Hofmann bromamide and Sandmeyer's reaction).
4. Synthesis of 2,4-dinitrophenyl hydrazine from chloro benzene. (Electrophilic and nucleophilic substitution reactions on aromatic ring).
5.Synthesis of 2-phenyllndole-Fischer Indole Synthesis. Synthesis of 3-nitrobenzoic from benzoic acid
6.Cannizaro's reaction of 4-chlorobenzaldehyde..

Book Recommended:

1.Vogel's Textbook of Practical Organic Chemistry

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-II)

CH416: Physical Chemistry Lab

Electroanalytical Techniques

Max. Marks: 60+15(Internal Assesment) **Labs Hrs.: 60**

1. To determine the partial molar volume of
(a) Glycine (b) Urea using dialtometer

2. To determine the partial molar volume of
(a) methanol (b) n-propanol using dilatometer

3. To determine the surface tension (double cabillary) of mixture of solid and water by deferential method and hence find out parachor of the mixture.

4. To determine the specific and molar refractivity of n-propanol, butanol, hexane and carbon tetrachloride and calculate refraction equivalents of C, H and Cl.

5. To determine the molar refracitivity of water, DMF, dioxane and mixtures of water, DFM, water-Dioxane and verify the refractivity rule. Predict about the interactions between components of mixture by plotting graph between refractive index and mole fraction.

6. To determine the equivalent conductance of weak electrolyte acetic at infinite dilution usingKohlrausch law.

7. Determine equivalent conductance of strong electrolyte at several concentrations and hence verifyonsagars equation.

8. Determine equivalent conductance of weak electrolyte, say, acetic acid at different concentrations and hence test validity of Oswald's dilution law. Also determine dissociation constant of the electrolyte.

9. To determine dissociation constant of a dibasic acid potentiometrically.

10. To study complex formation between Fe(III) and salicylic acid and find out the formula of the complex spectrophotometrically.

11. To determine the formula of the complex ion formed between Fe(III) and Thiocyante ion by Job's method.

12. To study the kinetics of hydrolysis of crystal violet spectrophotometrically.

13. To determine the pH of a buffer solution (*p*H less than 8) using a quinhydrone electrode.

14. To determine the pH of various mixtures of sodium acetate and acetic acid in aqueous solution and hence determine the dissociation constant of the acid.

15. Titrate potentiometrically Zn (II) by $K_4Fe(CN)_6$ and verify the composition of the complex $K_2Zn_3\ [Fe(CN)_6]_2$

16. Determination of nitrite in water spectrophotometrically.

17. Determination of molecular weight of polymers by Tirbiditymetery.

18. Determine the molar refraction of a solid substance by dissolving it in a solvent and its refractive index.

M.Sc. (Hons.) Chemistry (Semester-III)

CH417: Inoganic Chemistry-III

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

Biinorganic and Metal Clusters

60 hrs. **Time: 3 Hrs.**

Max. Marks: 60+15(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

UNIT-I

1. (a)Bioinorganic Chemistry **15 Hrs** Periodic survey of essential and trace elements, biological importance and relative abundance, Na^+/ K^+ion pump and its mechanism.

Porphyrine and metalloporphyrins, Oxygen carriers/storage-Hb and Mb: Structure and mechanism of their function, cooperativity and Bohr effect. Synthetic models of Hb, Cyanide, phosphine and carbon monoxide poisoning.

Inhibition and poisoning by ligand and metal ions, hemocyanin and hemerythrin, models of iron, coalt and copper.

Bioenergetic and ATP cycle process coupled to phosphate hydrolysis, Nucleotide transfer-DNA polymerase, phosphate transfer pyruvate kinase, phosphoglucomutase, creatin kinase, ATPase.

UNIT-II

1. (b)Bioinorganic Chemistry **15 Hrs**

Photosynthesis and respiration - chlorophyll : structure, function and its synthetic model. Xanthine oxidase, Gout Disease and its remedy.

Enzymes and their functioning, Bioredox agents, Zn-enzymes carboxipeptidase, carbonic anhydrase, superoxide dismutase, peroxidases and catalases,

Vitamin B_{12} coenzyme, structure, function and "Mn" mechanism and its application in organic synthesis, intake of alcohol and its remedy.

Cytochromes-structure and function, Cytochrome P_{450} enzymes.

Ferrodoxins and rubredoxins their structure and function. Abiological and biological N_2fixation and mechanism.

UNIT-III

1. (c)Bioinorganic Chemistry **15 Hrs**

Ferritin, transferring and siderophores and their structure and function.
Availability, competition, toxicity and nutrition of Iron, metal deficiency and diseases, toxic effects of antibiotics, chealte therapy, synthetic metal chelates as antimicrobial agents.
Calcium in living cell, transport and regulation and its mechanism.
Molecular aspects of intramolecular processes and their mechanisms.

2. Metal Clusters
(a)Reaction at Coordinated ligands
The role of metal ions in the hydrolysis of amino acid esters, peptides, and amides Molecular orbital concept of role of metal ions participation, Modified aldol condensation, Imine formation,
Template and Macrocyclic effect in detail.

UNIT-IV

(b) Metal to Metal Bonds and Metal atom Clusters **15 Hrs**
Metal carbonyl clusters, isoelectronic and isolobal relationship, high nuclearity carbonyl clusters(HNCC), Structural Patterns, synthetic methods, heteroatoms in metal atom clusters Carbide and nitride containing clusters, electron counting scheme for HNCC's, the capping rule, HNCC's for Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt.
Lower halides and chalcogenides clusters, octahedral metal halides and chalcogenides clusters($M_6M_8M_6M_{12}$ type).
Cheveral phases, triangular clusters and solid state xtended arrays. Compound with M-M multiple bonds, major structural types, quadruple bonds, other bond orders.
Intragoonal context relation of clusters to multiple bonds and one dimensional solids.

Books Recommended:
1. Principles of Bioinorganic Chemistry, S. J. Lippard and Berg, University Science Books.
2. J.E. Huheey : Inorganic Chemistry III & IV Ed. Pearson Education Asia – (2002).
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 5th Edition.
4. Purcell and Kotz: Inorganic chemistry. W. B. Saunders and Co., London
5. Bioinorganic Chemistry by D. Banergia

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

CH418: Organic Chemistry-IV

Natural Products

60 hrs. **Time: 3 Hrs.**

Max. Marks: 60+15(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

UNIT-I

1. Studies on Biosynthetic Pathways of Natural Products **10 Hrs**

a) The acetate hypothesis, poly-ketoacids, their addol type cyclisations and meta orientations of hydroxyl groups in naturally occurring phenols.

b) Isoprene rule, mechanism of formation of mevalonic acid from acctyl coenzyme, Biogenetic isoprene rule. Geranyl pyrophosphates and its conversion into alphapinene, thujene and borneol.

Farnesyl pyrophosphate, geranyl, geranyl pyrophosphate and mechanistic considerations for their interconversions into cadinene and abietic acid.

2. Terpenoids **5 hrs**

General classification, General Methods of structure determination, Chemistry of Camphor, Abietic acid, Santonin biosynthetic studies on tri and tetra terpenoids.

UNIT-II

3. Carbohydrates **8 Hrs**

Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars, N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides-cellulose and chitin.Storae polysaccharides – cellulose and chitin.Storate polysaccharides-starch and glycogen.Structure and biological functions of glucosaminoglycans or mucopolysaccharides.Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway.

4. Amino-acids, Peptides and Proteins **8 Hrs**

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins, forces responsible for holding of secondary structures. α-helix, β-sheets,

super secondary structure, triple helix structure of collagen, Tertiary structure of protein-folding and domain structure. Quaternary structure.
Amino- acid metabolism-degradation and biosynthesis of amino acids, sequence determination: chemical/enzymatic/mass spectral, recemization/detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH)

UNIT-III

5. Nucleic Acids 6 Hrs

Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acids (DNA), double helix model of DNA and forces responsible for holding it.Chemical and enzymatic hydrolysis of nucleic acids.The chemical basis for heredity, and overview of replication of DNA, transcription, translation and genetic code.Chemical synthesis of mono and trinucleoside.

6. Steroids 5 Hrs

General biosynthetic studies on steroids, chemistry of Cholesterol, cortisone, progesterone, oestrone, transformations in steroid molecules.

7. Alkaloids
5Hrs

Classification, chemistry of nicotine, quinine, papaverine, morphine and reserpine.

UNIT-IV

6. Haemin and Chlorophyll
5Hrs

Structure and synthesis of Porphyrins.Chemistry of Haemin and chlorophyll.

7. Antibiotics
5Hrs

Introduction, chemistry of pencillins, streptomycines, chloromphenicol, tetracyclins.

8. Prostaglandins
3Hrs

General study, nomenclature, structure of PGE and synthesis of PGE1, PGE2, PGF2x

Books Recommended:

1. Primary Metabolism: A Mechanistic Approach by J. Staunton, Oxford University Press, 1978.
2. Secondary Metabolism by J. Mann, Oxford University Press, Oxford, 1980.
3. Natural Product Chemistry - A mechanistic, Biosynthetic and Ecological Approach by Kurt B. G. Torssell, Swadish Pharmaceutical Society, 1997.
4. Principles of Biochemistry by A. L. Lehninger, CBS Publishers, New Delhi.
5. Fundamental of Biochemistry by D. Voet, J.G. Voet and C.W. Pratt, John Willey & Sons Inc., New York,1999.

M.Sc. (Hons.) Chemistry (Semester- III)
CH419: Physical Chemistry-III
Electrochemistry and Chemical Dynamics

60 hrs. **Time: 3 Hrs.**
Max. Marks: 60+15(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.
II. The students are required to attempt FIVE questions in all, ONE question from each unit and
the Compulsory question.
III. All questions carry equal marks.

UNIT-I

1.Electrochemistry
15Hrs

Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion-solvent interactions, Debye-Huckel-Bjerrum mode, Thermodynamics of electrified interface equation, Derivation of electro-capillarity, Lipmann equation(surface ecess), method of determination, structure of electrified interfaces, Guoy-Chpmann, Stern models, overpotential, exchange current density, derivation of Butler-Volmer equation, Tafel plot.
Semiconductor interface theory of double layer at semiconductor electrolyte solution interface, structure of double layer interfaces, effect of light at semiconductor solution interface. Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention.

UNIT-II

2.(a)Chemical Dynamics
15Hrs

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius theory and activated complex theory, ionic reactions, kinetic salt effects,, treatment of uni molecular reactions, Lindemann-Hinshelwood theory.

UNIT-III

2.(b)Chemical Dynamics
15Hrs

Dynamic Chain (hydrogen bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), Photochemical reactions between hydrogen-bromine and hydrogen-chlorine, oscillatory reactions (Belousov-Zhabotinsky reactions), Homogeneous catalysis and kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, , relaxation method, flash photolysis, nuclear resonance.

UNIT-IV

3.Voltmametry and Polarography

15Hrs

Polarography, polarographic cells, polarogram, interpretation of polarographic waves, equation for the polarographic waves, effect of complex formation on polarographic wave, polarograms for irreversible reactions, dropping mercury electrode, current variations during life time of a drop, merits and demerits of dme, polarographic diffusion currents, Ilkovic equation, capillary characteristics, temperature, polarograms for mixture of reactants, anodic and cathodic waves, factors affecting polarographic currents, applications of polarography, treatment of data, organic and inorganic polarographic analysis, voltammetry at solid electrodes, cyclic voltammetry and interpretation of data, , pilot-ion and standard addition method for quantitative analysis.

Books Recommended:

1. Chemical Kinetics, K. J. Laddler, McGraw-Hill
2. Modern Electrochemistry Vol.1,2,3, J. Bochris and A.K.N. Reddy
3. Fundamentals of electrochemistry; P. Monk
4. Principles of Instrumental Analysis; Skoog, West; Saundres Publications

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-IV)

CH420: Inorganic Chemistry-IV

Advanced Inorganic Chemistry

60 hrs. **Time: 3 Hrs.**

Max. Marks: 60+15(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

UNIT-I

1.Photoinorganic chemistry

17Hrs

Basics of photochemistry, Absorption, excitation, photochemical laws, quantum yield, electronically excited states, life times, measurements of the times, flash photolysis, energy diddipation by radiative and non-radiative processes, absorption spectra, franck condon principle, photochemical stages- primary and secondary processes, kashia's rules, thexi states, photosubstitution reactions, adamson's rules, photo substitution reactions of Cr(III) and Ru polypyridyles. Rh(III) ammine complexes. Ligand photoreactions, photoredox reactions, comparision of Fe^{2+} and Ru^{2+} complexes. Photo reactions and solar energy conversion, photosynthesis in plants and bacterio cholophyll synthesis, photolysis of water using inorganic precursors.

UNIT-II

2.Oxidative addition and Insersion reactions

15Hrs

Acid base behavior of metal atom in complexes, protonation and lewis base behavior, acceptor properties of lewis acidity of complexes, oxad and reductive elimination and their mechanism, addition of specific molecules, H_2 , HX and organic halide addition of some others molecules, reductive elimination, migration reactions their types, promotion of alkyl migration, insertion of CO into M-H bonds, other aspects of CO insertion reactions, transfer of other molecules, CO_2, SO_2, NO_2, RCN.

UNIT-III

3.Transition metal compounds with hydrogen and oxad reactions

13Hrs

Insertion of alkenes and C-C unsaturated compounds, cleavage of C-H bonds, alkane activation.Cyclometallation reactions in detail, reactions of free hydrocarbons.

Characterstics of hydride complexes, synthetic methods, chemical behavior of H^- complexes, mononuclear and homoleptic polyhydride anions, carbonyl H^- and anion H_2 compounds, M-H interactions. Complexes of boron and aluminium hydrides, synthetic applications of metal hydrides.

UNIT-IV

4. Structure and bonding of d-Block elements

15Hrs

Pervoskite, $Ti(NO_3)_4$, $TiCl_4(diars)_2$, $[Ti(OEt)_4]_4$, $Zr(BH_4)_4$, $[M_6X_{12}]^+$ (M= Nb & Ta; X= halide); $VO(acac)_2$; $VOCl_2(NMe_3)_2$, $[Nb(n^5\text{-}C_5H_5)H\text{-}\square\ (n^5,n^1\text{-}C_5H_4)]_2$; Isopoly and heteropoly acids of MO, W & V; $[M_6X_8]^{4+}$ M= MO & W; $CrO(O_2)$ (bipy); $[MO_2O_4(C_2O_4)_2\ (H_2O)_2]^{2+}$; $[W_3O_2\ (O_2CMe)_6\ (H_2O)_3]^{2+}$;$[Cr_3O(O_2CMe)_6\ L_3]^+$;$[H_2W_2(CO)_9]^{2+}$; Re_3Cl_9;$[ReH_9]^{3+}$; $ReCl_6(Pet_3)_2$; $Re_2Cl_6(PEt_3)_2$; $Re_2Cl_5\ (DTH)_2$, Roussin's salts; $[Ir_3O(SiO_4)9]^{10-}$; $[Ir_3N(SiO4)_6(H2O)_3]^{4-}$;$[Co(acac)_2]_4$, α and β-$MCl_2$ (M=Pd,Pt);Wolffram's salt;$[Ni(acac)_2]_3$; $Ni(Me_6\text{-}acac)_2$; Ni (Me-sal)$_2$; $[Cren_3]$ $[Ni(CN)_5]$ 1.5 H_2O; $[Ni\ (CN)_2\ (NH_3)]$. xC_6H_6; $[Pd(O_2CMe)_2]_3$, $[pt(O_2CMe)_2]_4$; $[PtMe_3(acac)]_2$; helical chian of AuF_3, Silver (III) etylenedibiguanide ion; $[CuXL]_4$ X=halide, L = P or As Ligand; $[Au_3Cl_2(PMe_2Ph)_{10}]^{3+}$; $[Zn(acac)_2]_3$; $[Cd\{S=C(NHCH_3)_2\}_2(SCN)_2]$; $Hg(NH_3)_2Cl_2$

Books Recommended:

1.Chemistry of Elements by N. N. Greenwood and Earnshaw, Perganon Press
2. W. W. Portfield: Inorganic Chemistry: A Unified approach
3. Cotton and Wilkinson: Advanced inorganic Chemistry: Vth edition

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-IV)

CH421: Organic Synthesis-V

Pericyclic and Photochemistry

45 hrs. **Time: 3 Hrs.**

Max. Marks: 40+10(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

UNIT-I

1. (a)Pericyclic Reactions **12 Hrs**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene, allyl system, classification of pericyclic reactions FMO approach. Woodward-Hoffmann correlation diagrams method and Perturbation of molecular orbital (PMC) approach for he explanation of pericyclic reactions under thermal and photo-chemical conditions.

Electrocyclic reactions – controtatory and disrotatory motions, 4n, 4n+2, allylsystems secondary effects. Cycloadditions – antrafacial and suprafacial additions, notation of cylcoadditions (4n) and (4n+2) systems with a greater emphasis on (2+2) and (4+2) cycloaddition-stereochemical effects and effects of substituents on the rates of cycloadditions, 1,3-dipolar cyclo-additions and cheleotropic reactions.

UNIT-II

1. (b)Pericyclic Reactions **10 Hrs**

Sigmatropic Rearrangements-suprafacial and antrafacial shifts [1,2]- sigmatropic shifts involving carbon moieties retention and invertion of configuration, (3,3) and (5,5) sigma-tropic rearrangements, detailed treatment of Claisen and Cope rearrangements, fluxional tautomerism, aza-cope rearrangements, introductions to Ene reactions, simple problems on pericyclic reactions. Elecrocyclic rearrangement of cyclobutenes and 1,3 cyclohexadienes.

UNIT-III

2. Photochemistry

(i) Photochemical Reactions **3 Hrs**

Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

(ii) Determination of Reaction Mechanism **3 Hrs**

Classification, rate constants and life times of reactive energy states –determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions.
Types of photochemical reactions – photodissociation, gas-phase photolysis.

(iii) Photochemistry of Alkenes **5 Hrs**

Intramolecular reactions of the olefinic bond – geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1, - dinenes.

UNIT-IV

(iv) Photochemistry of Carbonyl Compounds **6 Hrs**

Intramolecular reactions of carbonyl compounds – saturated, cyclic and acyclic, β, γ-unsaturated and α,β-unsaturated compounds, Cyclohexadienones. Intermolecular cycloaddition reactions – dimerisations and oxetane formation.

(v) Photochemistry of Aromatic Compounds **3 Hrs**

Isomerisations, additions and substitutions.

(vi) Miscellaneous Photochemical Reactions **3 Hrs**

Photo-Fries reactions of anilides.Photo-Fries rearrangement.Barton reaction.Singlet molecular oxygen reactions.Photochemical formation of smog.Photodegradation of polymers.Photochemistry of vision.

Books Recommended:

1. Pericyclic reactions: A Mechanistic study by S. M. Mukherji
2. The Conservation of Orbital Symmetry by R. B. Woodward and R. Hoffman
3. Organic Photochemistry – Chapman and Depuy.
4. Organic Photochemistry – W.H. Horsepool.
5. Photochemistry of Excited States – J.D.Goyle.
6. Fundamentals of Photochemistry by K.K. Rohtagi Mukherji

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-IV)

CH422: Organic Synthesis-VI

Reactive Intermediates, Disconnections, Organocatalysis, Heterocyclics

45 hrs. **Time: 3 Hrs.**

Max. Marks: 40+10(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

UNIT-I

1. (a)Organic Reactive Intermediates

12Hrs

(a)Carbanions: Chemistry of enolates and enamines, kinetic and thermodynamic enolates, Lithium and boron enolates in aldol and Michael reactions, alkylation and acylation of enolates, Nucleophilic additions to carbonyls and streroechemical aspects through various models (crams / cram chelation / Felkin-Anh models)

(b)Carbocations: Structure and stability of carbocations, classical and non classical carbocations, Neighbouring group participation.

(c)Carbenes and Nitrenes: Structute, generation addition and insertion and rearrangement reactions of carbenes such as wolf rearrangement. Generation of ylids by wolf decomposition.Structure, generation and reactions of nitrene and related electron deficient nitrogen intermediates.

UNIT-II

1.(b)Organic Reactive Intermediates

06Hrs

(d)Ylids: Chemistry of Phosphorous and Sulphur ylids-Wittig and related reactions, Peterson olefination etc.

(e)Radicals: Generation of radical intermediates and its addition to alkenes, alkynes for C-C bond formation and Baldwins rule. Fragmanetation and rearrangements reactions like decarboxylation, McMurry coupling etc.

2. Disconnection approach

05Hrs

An introduction to synthons and synthetic equivalents, disconnection approach, functional group interconversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, amine synthesis.

UNIT-III

3. Organocatalysis in Organic Synthesis

11Hrs

Introduction. Enamine catalysis: Aldol and Mannich type reactions, α-heteroatom functionalization, direct conjugate additions *via* enamine activation. Iminium catalysis: the catalysis concept, cycloaddition reactions, 1,4-addition reactions, transfer hydrogen, cascade reactions. Ammonium ions as chiral templates: Homogeneous catalysis with chiral quaternary ammonium salts, Heterogeneous catalysis-chiral phase transfer catalysis. Morita-Baylis-Hillman reaction: addition of ketones and aldehydes to activated olefins, asymmetric MBH reactions.

Asymmetric proton catalysis: conjugate addition reactions, hydrocyanation reactions, mannich reactions, aza-henry reaction, acyl Pictet-Spengler reaction, aza Friedel-Crafts reaction. Chiral Lewis bases as catalysts: allylation reactions, propargylation reactions, hydrocyanation and isonitrile addition, aldol type reactions, reduction of imines, epoxide ring opening. Asymmetric acyl transfer reactions. Nucleophilic N-Heterocyclic carbenes. Ylide based reactions.

Organocatalytic oxidations and reduction reaction.

UNIT-IV

4. Heterocyclic Synthesis

2Hrs

(a) Introduction

Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reaction.

(b) Small Ring Heterocycles

2Hrs

Three-membered and four-membered heterocyclic –synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes

(c) Six-Membered Heterocycles with one Heteroatom

4Hrs

Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pyridones.

Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones.

(d) Seven-and Large-Membered Heterocycles

3Hrs

Synthesis and reactions of azepines, oxepines, thiepines, diazepines, thiazepines, azocines,

diazocines, dioxocines and dithiocines.

Books Recommended:

1. Designing Organic Synthesis, S. Warren, Wiley
2. Organic Synthesis- Concepts, Methods and Starting Materials, J. Fuhrhop and G. Penzillin, Verlag VCH.
3. Advanced Organic Synthesis Part A and B, F.A. Carey and R. J. Sundberg, Plenum Press.

4. Principles of Organic Synthesis, R. Norman and J. M. Coxon, Blackie Acdemic & Professional.
5. *Modern Methods of Organic Synthesis* Cambridge University Press (1971). Carruthers, W.
6. Reactive Intermediates, Gilchrist and Rees

M.Sc. (Hons.) Chemistry (Semester-IV)

CH423: Physical Chemistry-IV

Analytical Techniques

60 hrs. **Time: 3 Hrs.**

Max. Marks: 60+15(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.
II. The students are required to attempt FIVE questions in all, ONE question from each unit and
the Compulsory question.
III. All questions carry equal marks**.**

UNIT-I

1.(a) Potentiometric Methods
15Hrs

Reference electrodes: Calomel electrodes, silver- silver chloride electrodes, precautions in the use of reference electrodes, metallic indicator electrodes and its types, metallic redox indicators, membrane indicator electrodes, classification of membranes, properties of ion-selective electrodes, the glass electrodes for pH measurement, composition and structure of glass membrane, the hygroscopicity of glass membrane, conduction across glass membrane, the membrane potential, the boundary potential, the potential of glass electrode, the alkaline and error, the glass electrodes for other cations, crystalline membrane electrode and their conductivity, the fluoride electrode, the electrode based on silver salts.

UNIT-II

1.(b) Potentiometric Methods
08Hrs

Direct potentiometric measurement, sign conventions, the electrode calibration method, calibration curves for concentration measurements, potentiometric pH measurements with a glass electrode, errors affecting pH measurements with glass electrode.

2. Thermal Methods
07Hrs

Thermogravimetric methods(TG) :Instrumentation, The balance, Furnace, instrument control, applications, Differential thermal analysis(DTA), instrumentation, general principles, applications, Differential scanning calorimetry(DSC), applications.

UNIT-III

3.Coulometric Methods
15Hrs

Current-Voltage relationships during an electrolysis, operation of a cell at a fixed applied potential, initial thermodynamic potential, estimation of required potential , current changes during an electrolysis at constant applied potential, potential changes during an electrolysis at constant applied potential, constant current electrolysis, electrolysis at a constant working electrode potential, An introduction to coulometric methods of analysis, units for quantity of electricity, types of coulometric methods, applications, coulometric titrations, applications of coulometric titrations, comparison of coulometric and volumetric titrations.

UNIT-IV

4. An Introduction to Chromatographic Separations
15Hrs

General description of chromatography, classification of chromatographic methods, Elution chromatography on columns, chromatograms, effect of migration rates and band broadening on resolution, Migration rates of species, partition coefficients, retention time, relationship between retention time and partition coefficients, the rates of solute migration(capacity factor), differential migration rates, the shape of chromatographic peaks, methods for describing column efficiency, definition of plate height, experimental evaluation of H and N, kinetic variables affecting band broadening, relationship between plate height and column variables.

Books Recommended:

1.Solid State Chemistry : A.R.WEST
2.Principles of Instrumental Analysis: Skoog and West
3.Principles of Instrumental Analysis : Willard, Merit and Dean

M.Sc. (Hons.) Chemistry (Semester-IV)
CH424: Physical Chemistry-V
Surface and Polymer Chemistry

60 hrs. **Time: 3 Hrs.**
Max. Marks: 60+15(Internal Assesment)

Instructions for paper setters and candidates

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.
II. The students are required to attempt FIVE questions in all, ONE question from each unit and
the Compulsory question.
III. All questions carry equal marks**.**

UNIT-I

1. Adsorption
15Hrs
Surface tension, capillary action, pressure difference across curved surface (Laplace equations), Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro-kinetic phenomena), catalytic activity at surfaces.

UNIT-II

2. Micelles
15Hrs
Surface active agents, classification of surface active agents, micellization, hydrophobic interactions, critical micellar concentration (CMC), factors affecting CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization , solubilization, micro emulsion, reverse micelles, applications of microemulsions.

UNIT-III

3. Macromolecules
15Hrs
(a) Polymer – definition, Different classifications of polymers , Linear, branched and network polymers. Basic concepts: monomers, repeat units, degree of polymerization. Types of polymers: electrically conducting polymers, Doping of polymers,mechanism of conduction, polarones and bipolarons, fire resistant, liquids crystal polymers,
Molecular mass: number, mass and viscosity average weights; Molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, kinetics of polymerization, thermodynamics of

polymerization. calculations of average dimensions of various chain structures.Importance of polymers,
Polymerization: condensation, addition, radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions.Polymerization in homogenous and heterogeneous systems.

UNIT-IV

(b) Structure and Properties:

15Hrs

Polymer structure and properties-crystalline melting point T_m-melting point of homogenous series, effect of chain flexibility and steric factors, entropy and heat of fusion. The glass transition temperature, T_g-Relationship between T_m and T_g, effects of molecular weight, diluents, chemical structure, chain topology, branching and chain linking. Property requirements and polymer utilization.

Books Suggested:

1. Physical Chemistry, P. W. Atkins.
2. Textbook of polymer science, F. W. Billmeyer Jr. Wiley.
3. Polymer science, V. R. Gowariker, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.
4. Polymer Chemistry, Melcolm P. Stevens, Oxford University Press.
5. Physical chemistry of polymers, A. Tager, Mir Publisher, Moscow.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

M.Sc. (Hons.) Chemistry (Semester-IV)

CH425: Inoganic Chemistry Practical

60 hrs. **Time: 3 Hrs.**

Max. Marks: 60+15(Internal Assesment)

(Any 8 Complexes.)

1. Preparation of $Co(acac)_3$, its characterization using NMR, IR, UV-Vis and analysis of Cobalt (ref. J. Chem. Edu., 1980, 57, 7, 525)

2. Preparation of Co. $(acac\text{-}NO_2)_3$, its characterization using NMR, IR, UV-Vis and analysis of Cobalt. (ref. J. Chem. Edu., 1980, 57, 7, 525)

3. Preparation of $[Fe(H_2O)_6][Fe(N\text{-salicyldeneglycinato})_2]_2.3H_2O$, its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Iron.(ref. Inorganica Chimica Acta, 1977, 23, 35).

4. Preparation of $[Ni(NH_3)_6]Cl_2$its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Nickel and NH_3. (ref. Marr and Rockett, 1972).

5. Preparation of $[Ni(ethylenediamine)_3]Cl_2$ its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Nickel. (ref. Marr and Rockett, 1972, page 270).

6. Preparation of $[Fe(NO)(S_2CN(Et)_2)_2]$ its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Fe(II). (ref. Marr and Rockett, 1972, page 262, J. Chem. Soc. 1962, 84, 3404).

7. Preparation of octahedral and tetrahedral complexes of dichlorodipyridylcobalt(II), differentiate them using IR, UV and magnetic properties. Estimate Co(II) from one of them. (ref. Marr and Rockett, 1972, page 375, Inorganic Chemistry, 1966, 5, 615).

8. Preparation of $VO(acac)_2$and its piperidine complex, characterize using IR, UV and magnetic moment. Estimate for V(IV). (ref. Marr and Rockett, 1972, 243).

9. Preparation of diaquotetraacetataocopper(II), magnetic susceptibility IR and UV-Vis, analysis of Copper(II).

10. Preparation of cis- and trans- potassium dioxalato diaquochromate(III). Interpretation of IR, UV and magnetic properties.Estimation of Chromium. (ref. Marr and Rockett, 1972, page 386).

11. Preparation of $HgCo(NCS)_4$, its IR and measure its magnetic moment. (ref. Marr and Rockett, 1972, page 365).

12. Preparation of sodium tetrathionate, interpretation of its IR and analysis using potassium iodate. (ref. Marr and Rockett, 1972, page 214).

13. Preparation of Potassium dithionate, interpretation of its IR and analysis using potassium iodate. (ref. Marr and Rockett, 1972, page 214).

14. Preparation of bis(acetylacetonato)copper(II), UV-Vis, and IR, magnetic studies, Demonstration of Jahn Teller effect by solution spectral studies. (ref. Bull. Chem. Soc. Japan, 1965, 29, 852).

15. Preparation of salicylamide complexes of Copper(II). IR, UV, magnetic data and analysis of Cu(II). (ref. Indian J. of Chem., 1977, 15A, No. 5, 459; ibid, 1971, 9, 1396).

16. To prepare a macrocyclic ligand 5,7,7,12,14,14-hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienedi(hydrogeniodide) and its complex with Ni(II). Study IR, NMR and UV-Vis of ligand and complex and magnetic properties of complex. To analyze for Ni and I. (J. Chem. Edu. 1977, 79, 581).

17. Preparation and resolution of tris (ethylenediamine) cobalt (III). UV-Vis, NMR, IR, optical rotation of the resolved complexes. ((ref. Marr and Rockett, 1972, page 386).

Recommended Book:

1. B.N. Figgis, Introduction to Ligand Field, Wiley Eastern.
2. A.B.P. Lever, Inorganic Electronic Spectroscopy, Elsevier.
3. A.Earnshaw, Introduction to Magnetochemistry, Academic Press.
4. J.E. Huheey, Inorganic Chemistry Principles of Structure and Reactivity, Harper Interscience.
5. R.S. Drago, Physical Medhod in Chemistry, W.B.Saunders Company.
6. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Int

M.Sc. (Hons.) Chemistry (Semester-IV)

CH426: Advanced Organic Chemistry Practical

60 hrs. **Time: 3 Hrs.**

Max. Marks: 60+15(Internal Assesment)

1. Synthesis and Reactivity of benzalacetophenone
   a. Bromination (Electrophilic additions) & subsequent debromination (Elimination)
   b. Epoxidation (Cycloaddition, nucleophilic) and ring opening with hydroxide ion.
   c. Michael addition of aniline.
   d. Conversion of benzalacetophenone to its oxime (nucleophilic addition at C=O)
   e. Conversion of oxime to amide (Beckmann rearrangement) and oxazole
   (Understand the reactivities at conjugated C=O and C=C) bond.

1. Synthesis of Cyclohexene from cyclohexanol and its conversion to 1, 2- *cis* and 1, 2- *trans*-cyclohexanediols.
   a. Epoxidation with peracid (Cycloaddition) and *anti*- ring opening with sodium hydroxide to *cis*- cyclohexane -1, 2- diol.
   b. Dihydroxylation with $KMnO_4$
   (Mechanism of *syn*- and *anti*-cyclohexane-1,2-diol)

2. Preparation and characterization of the Aldol-dehydration products from various combinations of aromatic aldehydes and ketone. Effect of substituents on aromatic aldehydes on the product distribution.
   a. Aldehyde:benzaldehyde, 4-methylbenzaldehyde. 4-methoxybenzaldehyde.
   b. Ketone: acetone, cyclopentanons, cyclohexanone (Book 4)6.

Recommended Books:

1. An Introduction to Modern Experimental Organic Chemistry, R.M. Roberts, J.C. Gilbert, L.B.
Rodewald and A.S Wingrove, Holt Rinehart and Winston Inc, New York. 1969.
2. Vogel's Text Book of Practical Organic Chemistry.
3. Laboratory Experiments on Organic Chemistry, R. Edemas, J.R. Johnson and C.F. Wilcox, The Macmillan Limited, London, 1970.
4. Modern Projects and Experiments in Organic Chemistry, J.R. Mohrig, C.N. Hammonad, P.F.
Schatz and T.C. Morrill, W.H. Freeman and Company, New York 2003.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

Inorganic Chemistry–A

Time: 3 Hrs. **Max.Marks:32+08(Internal Assesment)**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximumlength of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to beattempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 15 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Twoquestions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 4.5 marks, total weightage being 9 marks.

Unit – I

Introduction, Wemer's coordination theory, naming of co-ordinate complexes.
Co-ordination numbers 1-12 and their stereo-chemistries. Co-ordination numbers and stereo chemistries of the common transition metal : Ti,V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, & W. Factors affecting co-ordination numbers and stereo-chemistry Isomerism in coordination compounds. **(Books Consulted-Number 1,3,8).**

Unit – II

Valence bond theory for co-ordinate complexes, inner and outer orbital complexes, electro-neutrality and back bonding, limitations of V.B. theory.**(Books 5,9)**

Unit – III

Crystal field theory-Spliting of d-orbitals in octahedral, tetrahedral, cubic and square planer fields of ligands, calculation of C.F.S.E. in high spin and low spin octahedral and high spin tetrahedral complexes, factors affecting the 10 Dq value, structure effects of crystal field splitting (Jahn-Teller distortion). Paramagnetism, diamagnetism, ferro and anti ferromagnetism, Microstates and spectroscopic terms, a calculation of spectroscopic terms for d^1 –d^2 electronic configurations using LS coupling, Hunds rule for finding the ground state term, limitations of C.F.T.

Unit – IV

Molecular Orbital Theory- Evidence for covalent character in bonding, MOEL diagram for octahedral and tetrahedral complexes involving σ as well as π bonding, charge transfer transitions.**(Books consulted No. 3,4,5,6,7,8)**

Books Recommended:

1. G.L. Eichorn, Inorganic Biochemistry, Vol. I Elsevier,
2. R.Hilgenfeld & W.Saengar, Topics in Current Chemistry, Vol.101.page 38-65.
3. J.E. Huheey, Inorganic Chemistry, 3rd ed.
4. F.A. Cotton & G. Wilkinson, Advanced Inorganic Chemistry.
5. B.E. Douglas & D.H. McDaniel, Concepts & Models of Inorganic Chemistry,1970.
6. A. Earnshaw, Introduction of Magnetochemistry, Academic press,1968.
7. R.S.Drago, Physical Methods Inorganic Chemistry, 1971.
8. F. Basalo & R.C. Johson, Co-ordination, Chemistry, 1964.
9. Cowan, J.A. (1997) – Inorganic Biochemistry – An In troduction, Wiley-VCH.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

Inorganic Chemistry (Practical)

Time: 3 Hrs. **Max. Marks: 16+04(Internal Assesment)**

Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

- Volumetric Analysis:

Iodimetry, Iodometry, Redox titrations using $K_2Cr_2O_7$ and $KMnO_4$.

Complexometric titration using EDTA Ca^{++},Mg^{++}: in context with study of hardness of water.

Department of Chemistry, Khalsa College, Amritsar
Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

Organic Chemistry–A

Time: 3 Hrs. **Max.Marks:32+08(Internal Assesment)**
Periods: 3
Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximumlength of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to beattempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 15 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Twoquestions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 4.5 marks, total weightage being 9 marks.

UNIT-I

Conformations of alkanes and cycloalkanes; conformational analysis of ethane, Butane, cyclohexane, monosubstituted and disubstituted cyclohexane, conformation of small, medium and large ring cycloalkanes and of polycyclic ring systems. Factors that affect reaction rates of these reactions, structure and relative stabilities of free radicals, halogenation, mechanism of chlorination of methane, selectivity in chlorination and bromination of higher alkanes .

Alcohols as Bornsted bases and acids, reactions of alcohols with hydrogen halides with detailed mechanism structure and bonding in carbocations and their relative stabilities, potential energy diagrams for chemical reactions.

UNIT-II

Stereochemistry of alkenes, naming stero isomeric alkenes by E-Z system, mechanism of hydrogenation of alkenes, stereochemistry of hydrogenation of cycloalkenes, Dehydration of alcohols and regioselectivity of these reactions, Acid catalysed dehydrohalogenation of alcohols with complete mechanistic discussion, Mechanism of dehydrohalogenation of alkylhalides (E_1 mechanism), stereoselective and antielimination in E_2 reactions, the E_1 Mechanism, electrophilic addition of hydrogen halides to alkenes its regioselectivity explained on the basis of mechanism , free radical addition of hydrogen bromide to alkenes, acid catalysed hydration of alkene with mechanism stereochemistry of halogen addition to alkenes and its mechanistic explanation. Hypohalous acid addition to alkenes, epoxidation of alkenes.

UNIT-III

Stereochemistry: Molecular chirality, enantiomers/symmetry in achiaral structures, chiralcentres in chiral molecules, properties of chiral molecules-optical activity, absolute and relative configuration, the Cahn-Ingold Prelog R-S notional system physical properties of enantiomers. Stereochemistry of chemical reactions that produce chiral centres, chemical reactions that produce stereoisomers, Resolution of enantionmers, chiral centres other than carbon, prochirality.

UNIT-IV

Functional group transformation by nucleophilic substitution, the biomolecular (SN^2), mechanism of nucleophilic substitution , stereochemistry of SN^2 reactions, how SN^2 reactions occur, steric effect in SN^2 reactions, nucleophiles and nucleophilicity,the unimolecular (SN^1) mechanism of nucleophilies substitution, carbocation stability and the rate of substitution, by the SN^1 mechanism sterochemistry of SN^1 reactions, carbocation real arrangements in SN^1 reactions, solvent effects, subtitution and elimination as competing reactions. The SN^1 -SN^2 continum.

Books Recommended:

1. R.T. Morison and R.N. Boyd, Organic chemistry
2. I. L. Finar, Organic Chemistry, Vol.I, IV ed. J. March, Advanced Organic Chemistry, Reactions Mechanisms and Structure.
3. Schaum's Outlines Series, Theory and Problems of Organic chemistry.
4. I.L. Finar, Problems and their solution in Organic chemistry.
5. J. D. Robert and M. C. Caserio, Modern Organic Chemistry.
6. D. J. Cram and G. S. Hammond, Organic chemistry.
7. J. E. Banks, Naming Organic Compounds - Programmed Introduction to Organic Chemistry
8. E.L. Eliel, Stereochemistry of carbon compounds.
9. W. Camp, Organic Spectroscopy.
10. F. A. Carey, Organic chemistry.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-I)

Organic Chemistry (Practical)

Time: 3 Hrs.Max. Marks: 16+04(Internal Assesment)

Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

Organic qualitative analysis:
Complete identification including derivation of following organic compounds:

- Aromatic hydrocarbons
- Aldehydes
- Ketones
- Carbohydrates

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

Inorganic Chemistry-B

Time: 3 Hrs. **Max.Marks:32+08(Internal Assesment)**

Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximumlength of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to beattempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 15 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Twoquestions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 4.5 marks, total weightage being 9 marks.

Unit – I

л-Acid ligands

Carbon monooxide complexes, Two methods of preparation, structural and bonding in (linear MCO groups, polynuclear metal carbonyls carbonyl hydrides and halides). Complexes of N_2, with Ru and No with Fe.**(Book consulted, No. 4 Chapter 2)**

Unit – II

Alkali metal and alkaline earth metal chelators

Definition and few examples of macrocyclic ligands, macrocyclic effect, crown ethers & podands, coronauds, cryptands, structure of 18 crown -6 complex with KNCS, ion cavity complex, effect of anion on phase transfer catalysis, sandwich formation, cryptands and their cation complexes. **(Book No. 2 pages 38-65).**

Unit –III

Stability of co-ordination compounds

Introduction Factors affecting the stability of metal ion complexes with general ligands and some biochemical ligands like amino acids, peptides, nucleotides and Nucleic acids and porphyrin **(Book consulted No. 1 Chapter 2).**

Unit – IV

Metal ions in biological system

Fe: Haemoglobin, structure and functions, oxygen transport, Bohr effect.

Mg: Chlorophyll structure and function in photosysthesis.

Zn: Carboxypeptidase enzyme functions.

(Book consulted, No. 9 Page No. 37-76).

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

Inorganic Chemistry (Practical)

Time: 3 Hrs..Max. Marks: 16+04(Internal Assesment)

Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

- Inorganic qualitative analysis:

Four ions (Two cations two anions).

A. Preliminary tests: Physical examination, Dryheating test, charcoal cavity test, $Co(NO_3)_2$ test, flame test, borax bead test.

B. Acid radical analysis:

Dil H_2SO_4 gp: CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-}
Conc, H_2SO_4 gp: Cl^-, Br^-, I^-, NO_3^-, CH_3Coo^-
Individual gp: SO_4^{2-}, PO_4^{3-}, BO_3^{3-}

C. Basic radical analysis:
NH_4^+ Pb^{2+}, Cu^{2+}, Cd^{2+}, Fe^{2+} or Fe^{3+}, Al^{3+} , Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, $Ca^{2+}Mg^{2+}$, Na^+,K^+ and their confirmation.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

Organic Chemistry–B

Time: 3 Hrs. **Max.Marks:32+08(Internal Assesment)**

Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximumlength of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to beattempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 15 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Twoquestions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 4.5 marks, total weightage being 9 marks.

Unit -I

Acidity of acetylene and terminal alkenes, metal ammonia reduction of alkyne, addition of hydrogen halides and water to alkyne, with detailed discussion of mechanism of these reaction, the Diels Alder reaction, orbital symmetry and the Diels alder reaction.

Unit -II

Conversion of alcohol to ether and ester with full dicussion of the reaction, crown ethers, conversion of vicinal halohydrin to epoxides, nucleophillic ring opening reaction of epoxides, acid catalysed ring opening of epoxides.

Unit -III

Principles of nucleophillic additon to carbonyl groups: Hydration ,acetal formation , cyanohydrin formation ; reaction with primary and secondary amines, Wittig reaction, steroselective addition to carbonyl groups mechanism of halogenation ,acid and base catalysed cholization, haloform reaction ,aldol condensaton, conjugate nucleophillic additon to unsaturated carbonyl compounds.

Unit - IV

Mechanism of acid- catalysed esterification,intramolecular ester formation lactone), Hell-Volerid-Zelinsky reaction, decarboxylation of malonic acid and related compounds. Mechanism of hydrolysis of acid chlorides, acid anhydrides, acid and base catalysed hydrolysis of esters, acid assisted hydrolysis of amides. Hoffman rearrangement of N-bromoamides. Hydrolysis of nitriles, claisen condensation ,the Deckmann condensation, acetic ester synthesis, malonic ester synthesis, Michael reaction Reformatsky reaction.

Books Recommended:

1. R.T. Morison and R.N. Boyd, Organic Chemistry
2. I. L. Finar, Organic Chemistry, Vol.I, IV Ed.
3. J. March, Advanced Organic Chemistry, Reactions Mechanisms and Structure.
4. Schaum's Outlines Series, Theory and Problems of Organic Chemistry.
5. I.L. Finar, Problems and their Solution in Organic Chemistry.
6. J. D. Robert and M. C. Caserio, Modern Organic Chemistry.
7. D. J. Cram and G. S. Hammond, Organic Chemistry.
8. J. E. Banks, Naming Organic Compounds - Programmed Introduction to Organic Chemistry
9. E.L. Eliel, Stereochemistry of Carbon Compounds.
10. W. Camp, Organic Spectroscopy.
11. F. A. Carey, Organic Chemistry.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) (SEMESTER-II)

Organic Chemistry (Practical)

Time: 3 Hrs. **Max. Marks: 16+04(Internal Assesment)**

Periods: 4

Note: The question paper will be set by the examiner based on the syllabus.

Organic qualitative analysis:
Complete identification including derivation of following organic compounds:

- Amides
- Amines
- Carboxylic acids and phenols.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

Physical Chemistry – A

Time: 3 Hrs. **Max.Marks:32+08(Internal Assesment)**

Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximumlength of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to beattempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 15 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Twoquestions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 4.5 marks, total weightage being 9 marks.

Unit-I

Chemical Thermodynamics:

State of a system, state variables, thermodynamic equilibrium, thermodynamic properties, Intensive and Extensive properties, various types of processes. First Law of Thermodynamics, internal energy and enthaply, change in internal energy and change in enthalpy for expansion of real and ideal gases under isothermal and adiabatic conditions for reversible and irreversible processes. Relation between Cp and Cv. Internal energy change and enthaply change in a chemical process.Hess's law of heat summation.Enthaply of formation, enthaply of ionisation and calculation of bond dissociation energies from thermochemical data.

Unit-II

Second law of thermodynamics, entropy and Gibb's free energy, Carnot's cycle, Calculation of entropy change for reversible and irreversible processes under isothermal and non-isothermal conditions.Gibbs Hemholtz equation.Third law of thermodynamics, Nernst heat theorem, calculation of absolute entropies of substances.Meaning of chemical equilibrium, homogeneous and heterogeneous equilibria. Thermodynamic derivation of law of chemical equilibrium, Van't Hoff relation, Relation between free energy change and equilibrium constants Kp Kc and Kf. Temperature and pressure dependence of equilibrium constant.

Unit-III

Solutions:

Definition, types of solutions, vapour pressure of solution and Raoult's law. Factors influencing the solubility of gas in liquids, Henry's law.Ideal solutions, Duhem Margules equation.Distillation of ideal solutions, Lever rule, vapour pressure of ideal solutions and non ideal solutions.Distillation of non ideal solutions. Azeotropes, colligative properties, lowering of vapour pressure, depression in freezing point, elevation in boiling point, osmotic pressure. Their common features and applications.Thermodynamic derivation of elevation in boiling point, depression in freezing point and osmotic pressure.Van't Hoff factor and its application to calculate degree of association and degree of dissociation.

Unit-IV

Phase Equilibria:

Definition of phase, component and degree of freedom, Phase rule and its thermodynamic derivation. Derivation of Clausius-Clapeyron equation and its importance in phase equilibria, phase diagrams of water system, KI water system and lead-silver system.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

Physical Chemistry – A Practical

Time: 3 Hrs.Max. Marks: 16+04(Internal Assesment)

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Surface tension: Determination of surface tension of a given liquid by Stalgometer. Using number of drops and weight of drops methods
2. Determination of coefficient of viscosity of a pure liquid (Acetone, Ethanol, Propanol, Butanol, Glycol) (Effect of hydrogen bonding on viscosity)
3. Photometry.

   Verification of Lambert beer's law for solution of $CoCl_2H_2o$ (in water) and $K_2Cr_2O_7$ (in water)
4. a) pH of buffer solution

   b) Acid base titration HCl vs. NaOH.

   c) Determination of ionization constant of a weak acid (CH_3COOH)
5. Study of distribution law of Benzoic acid between benzene and water.
6. Study of distribution law by iodine distribution between water and CCl_4. Given standar solution $Na_2S_2O_3$.
7. Determine composition of HCl and CH_3COOH in the given solution pH metrically.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

Physical Chemistry – B

Time: 3 Hrs. **Max.Marks:32+08(Internal Assesment)**

Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximumlength of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to beattempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 15 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Twoquestions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 4.5 marks, total weightage being 9 marks.

Unit-I

Electrochemical Cells:

Electrode poential, Electromotive force (EMF).Reversible and irreversible cells, measurement of EMF of a cell.Nernst equation.Reference electrodes and other electrodes, standard electrode potential.Activity and activity coefficient determination from EMF results. Concentration cells with transference and without transference, liquid function potential, pH, glass electrode, quinone-hydroquinone electrode, Potentiometric titrations.

Unit-II

Chemical Kinetics:

Rate of reaction, rate constant, factors influencing rate of reaction, order, molecularity. Rate equations for Ist order, IInd order & IIIrd order reactions. Methods for determining order of reaction. Half Life, Complex reactions, consecutive reactions, parallel reactions, chain reactions and opposing reactions.Activation energy and calculation from Arrhenius equation. Theories of reaction rates collision theory and transition state theory of biomolecular processes. Catalysis, acid base catalysis, enzyme catalysis including their mechanisms, Michaelis Menten equation for enzyme catalysis.Heterogeneous catalysis and its mechanism. Surface reactions with special reference to Unimolecular surface reactions.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

Unit-III

Ionic Equilibria and Conductance: Conductivity, equivalent and molar conductance. Variation of equivalent conductance with dilution of weak and strong electrolytes.Arrhenius and Debye Huckel theory.Kohlraush law of independent migration of ions.Transference number and their experimental determination using Hittorf and moving boundary methods.Ionic elocity, ionic mobility.Applications of conductance measurements. Determination of degree of ionisation of weak electrolyte, solubility, solubility product of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt, conductometric titrations. Ionic strength.Debye Huckel theory of activity coefficients.Mathematical treatment of multistage equilibria of acids and bases.Salt hydrolysis, calculation of hydrolysis constant, Buffer solutions, Buffer index, Buffer capcity universal buffer preparation.Acid base indicators.Theory of acid base indicators.pH change and selection of indicators in different acid base titrations.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–IV)

Physical Chemistry – B Practical

Time: 3 Hrs.Max. Marks: 16+04(Internal Assesment)

Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Refractometry: Determine refractive index of a given liquid as a criterion for its purity. (Benzene i.e. commercial) benzene + A.R. acetone).

2. Polarimetry: Determine the %age composition of an optically active solution.

3. Calorimetry:
   a) Determination of Heat of neutralization
      (i) Strong acid-strong base
      (ii) Weak acid-strong base.
   b) Determination of Heat of solution of KCl, NH_4Cl, KNO_3

4. Conductometry:
   a) Determination of cell constant.
   b) Determination of specific and equivalent conductance of electrolyte (NaCl and HCl).
   c) Precipitation titration of Na_2SO_4 vs. $BaCl_2$.
   d) Neutralization titrations NaOH vs. HCl and NaOH vs. CH_3COOH.

5. Determination of adsorption isotherm of oxalic acid on charcoal.

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

Physical, Organic & Inorganic Aspects of Spectroscopy-A

Time: 3 Hrs. **Max.Marks:40**

Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximumlength of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to beattempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Twoquestions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT – I

1. Energy and Electromagnetic Spectrum

Introduction, electromagnetic spectrum and Units, regions of the spectrum, basic features of different spectrometers, statement of Born-Oppenheimer approximation, degree of freedom, Frank Condon Principle, Fluorescence and Phosphorescence.

UNIT – II

II. Ultraviolet and Visible Spectroscopy

The energy of electronic excitation, measurement techniques, Beer-Lambert Law, Molar extinction coefficient. Different types of transition noticed in UV spectrum of organic functional groups and their relative energies. Chromophore, auxochromes, Absorption and intensity shifts, Transition probability. Factors affecting λ_{max} Effect of steric hindrance to coplanarity, Solvent Effects.

UNIT – III

III. Infrared Spectroscopy

Vibrational Energy Levels, Selection Rules, Force Constant, Fundamental Vibration Frequencies, Factors influencing Vibrational Frequencies (Vibrational Coupling, Hydrogen Bonding, Electronic effect, Bond Angles, Field Effect) of different functional groups. Sampling Techniques.

UNIT – IV

IV. Applications of UV and IR Spectroscopy

Applications of UV spectroscopy, Woodward Fieser rules for calculating λ_{max} of conjugated polyenes and α,ß -unsaturated carbonyl compounds. Applications o f IR spectroscopy, Absorption of Common functional Groups, Interpretation of simple IR spectra, Finger print Regions. Simple numerical problems based on UV and IR spectroscopy.

Books Recommended:

1. Organic Spectroscopy By W. Kemp; Publisher- Palgrave, New York
2. D.H. Williams and I. Fleming. Spectroscopic Methods in Organic Chemistry.
3. Spectrometric Identification of Organic Compounds - R.M. Silverstein & F. X. Webster; Publisher: John Willey and Sons,Inc.
4. Introductory Problems in Spectroscopy- By R.C. Banks, E.R. Matjeha and G. Mercer; Publisher : The Benzamine / Cummings Publishing Company Inc.
5. Introduction to Spectroscopy – D. L. Pavia, G. M . Lampman, and G. S. Kriz Publisher: Brooks / Cole, a part of cengage learning

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) SEMESTER-V

Physical, Organic & Inorganic Aspects of Spectroscopy-A (Practical)

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Record of IR spectra of diethyl ether, ethyl acetate and butanone and make its comparisons.

2. Synthesis and electronic spectral studies of d-d bands of $[Ni(NH)_3]Cl_2$ and $[Ni(en)_3]Cl_2$ complexes. A comparison of their electronic spectra with that of $[Ni(H2O)_6]Cl_2$ for the calculation of 10Dq values.

3. Covert cyclohexanone to cyclohexanol and hydrazine of cyclohexanone. Compare the UV-Vis and IR spectra of te products with that of the starting material.

4. Preparation of $[Fe(py)_4(NCS)_2]$ and its IR characterization.

5. Take a commercial sample of methyl orange and record its UV-Vis and florescence spectra under neutral, acidic and basic medium and make comparisions.

6. To verify Beer-Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of given $KMnO_4/K_2Cr_2O_7$

Department of Chemistry, Khalsa College, Amritsar

Academic Year:2015-16

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

Physical, Organic & Inorganic Aspects of Spectroscopy-B

Time: 3 Hrs. **Max.Marks:40**

Periods: 3

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A: 8 very short answer type questions are to be set, two from each unit, the maximumlength of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B: This section will comprise of 8 questions, two from each unit. 5 questions to beattempted and maximum length of answer can be upto two pages. Each question will carry 4 marks, total weightage being 20 marks.

Section-C: This section will comprise of four essay type questions, one from each unit. Twoquestions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 6 marks, total weightage being 12 marks.

UNIT-I

I. Proton Magnetic Resonance spectroscopy (1H NMR)

The Nuclear spin, Larmor frequency, the NMR isotopes, population of nuclear spin level, spin and spin lattice relaxation. Measurement techniques (CW & FT method), solvent used.

Chemical shift, reference compounds, shielding constant, range of typical chemical Shifts simple application of chemical shifts, Anisotropic effect. Spin spin splitting, Coupling constant.

UNIT-II

II. Applications of NMR spectroscopy

NMR spectra with various examples such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene, o-, m-, p- anisidine, o-, m-, p- nitrophenols, acetophenone. Simple numerical of structure elucidation of NMR spectroscopic data.

UNIT- III

III. Mass Spectrometery

Basic Principles Elementary theory. Molecular ions, isotope ions, fragment ions of odd and even electron types, Nitrogen rule, Factors affecting cleavage patterns, simple cleavage, cleavages at a hetero atom, multicentre fragmentations, rearrangements, diels – alder fragmentation, Mc Lafferty rearrangement.

UNIT- IV

IV. Applications of Mass Spectroscopy

Cleavage associated with common functional groups , Aldehydes, ketones cyclic and acyclic esters, alcohols, olefins, aromatic compounds amines, Interpretation of the spectrum of unknown simple molecules.

Books Recommended:

1. Organic Spectroscopy By W. Kemp; Publisher- Palgrave, New York
2. D.H. Williams and I. Fleming. Spectroscopic Methods in Organic Chemistry.
3. Spectrometric Identification of Organic Compounds - R.M. Silverstein & F. X. Webster; Publisher: John Willey and Sons,Inc.
4. Introductory Problems in Spectroscopy- By R.C. Banks, E.R. Matjeha and G. Mercer; Publisher : The Benzamine / Cummings Publishing Company Inc.
5. Introduction to Spectroscopy – D. L. Pavia, G. M . Lampman, and G. S. Kriz Publisher: Brooks / Cole, a part of cengage learning

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

Physical, Organic & Inorganic Aspects of Spectroscopy-B Practical

Time: 3 Hrs. **Max. Marks: 20**
Periods: 4

Note. The question paper will be set by the examiner based on the syllabus.

1. Record the ^{1}H NMR spectra of ethyl acetate and ethyl acetoacetate(in $CDCl_3$ or CCl_4) and show the presence of the tautomeric structures.

2. Preparation of benzillic acid from benzaldehyde.(Green Chemistry Experiment)

3. Separation of components of spinach using column chromatography.

4. Prepare *p*-nitroacetanilde and make comparison of ^{1}H NMR spectral data of aniline, acetanlide(starting material) and *p*-nitroacetanide product.

5. Compare IR and ^{1}H NMR spectra of aspirin and salicyclic acid