

# FACULTY OF SCIENCES

## SYLLABUS

FOR

### B.Sc. (Hons) Math (Semester I-II) Session: 2018-19



### KHALSA COLLEGE AMRITSAR

*(An Autonomous College)*

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*B.Sc. (Hons)*  
*Math*  
*Semester-I*

*B.Sc. (Hons) Math Semester-I*  
**Organic Chemistry-I**

**45 Hrs.**

**Max. Marks: 37+13 (Internal Assessment)**

**Time: 3 Hrs/week.**

**Instructions for paper setters and candidates**

- I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
- II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
- III. Section-I will consist of eight short answer type questions carrying 1½ mark each. Students are required to attempt any six questions.
- IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 7 Marks.
- V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

**UNIT-I**

**10Hrs**

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

**UNIT-II**

**12Hrs**

**Chemistry alkanes and alkenes:** 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. Stereochemistry of alkenes, naming stereo isometric alkenes by the E-Z system, mechanism of hydrogenation of alkenes, stereochemistry of hydrogenation of cycloalkenes, Dehydration of alcohols and regioselectivity of these reactions. Acid catalysed dehydration of alcohols with complete mechanistic discussion, Mechanism of dehydrohalogenation of alkylhalides (E mechanism), stereoselective and antielimination in E reactions, the E 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.

**Alkynes:** Acidity of acetylene and terminal alkenes, metal ammonia reduction of alkyne, addition of hydrogen halides and water to alkynes, with detailed discussion of mechanism of these reactions, the diels Alder reaction, orbital symmetry and the diels Adler reaction.

**UNIT-III**

**12Hrs**

**Nucleophilic substitution and addition reaction:**

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

(b) Principles of nucleophilic addition to carbonyl groups : Hydration acetal formation, cyanohydrin formation ; reactions with primary and secondary amines, Whittig reaction, steroselective addition to carbonyl groups mechanism of halogenation, acid and base catalysed cholorination, haloform reaction, aldol condensation, conjugate nucleophilic addition to unsaturated carbonyl compounds

**UNIT-IV**

**11Hrs**

**Spectroscopy:** Principles of molecular spectroscopy, electromagnetic radiation, quantized energy states, NMR(H) Spectroscopy, nuclear shielding and Chemical shift measurements chemical shift and molecular structure, interpreting proton NMR spectra, spin- spin splitting in NMR spectroscopy, patterns of spin-spin splitting, proton NMR spectra of alcohols, NMR and conformations carbons- 13 nuclear magnetic resonance, the sensitivity problem, interpretation of spectra. Infrared spectroscopy, ultraviolet-visible (UV-VIS) spectroscopy and mass spectrometry.

**Text and Reference Books:**

1. R.T. Morison and R.N. Boyd, Organic Chemistry.
2. I.L. Finar, Organic Chemistry, Vol. I IV ed.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure by J. March.
4. Schaum's Outlines Series Theory and Problems of Organic Chemistry by Herbert Meislick and Jacob Sharefkin
5. Problems and their solution in Organic chemistry by I.L. Finar, Modern Organic Chemistry by J.D. Robbert and M.C. Caserio.
6. Organic Chemistry by D.J. Cram and G.S. Hammond.
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.

*B.Sc. (Hons) Physics/Math Semester-I*  
Organic Chemistry Practical  
BHMH-109

**Max. Marks: 22+8 (Internal Assessment)**

**Labs 3 Hrs/week**

The preliminary examination of physical and chemical characteristics (physical state, colour, odor and ignition tests), elemental analysis (nitrogen, sulphur, chlorine, bromine, iodine), solubility tests including acid-base reactions, classification tests involving functional reactivity other than acid-base test, preparation of derivatives for given pure organic compounds.

The following categories of compounds should be analyzed.

- phenols, carboxylic acids
- carbonyl compounds - ketones, aldehydes
- carbohydrates
- aromatic amines
- aromatic hydrocarbons

**Suggested Book:**

Practical Organic Chemistry by F.G. Mann and B.C. Saunders

*B.Sc. (Hons)*  
*Math*  
*Semester-II*

*B.Sc. (Hons) Math Semester-II*  
Inorganic Chemistry-II

**45 Hrs.**

**Time: 3 Hrs/week.**

**Max. Marks: 37+13 (Internal Assessment)**

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**UNIT-I**

**12Hrs**

**Co-ordination Chemistry:** Introduction, Werner's coordination theory, naming of co-ordinate complexes. Co-ordination numbers 1-12 and their stereo-chemistries. Factors affecting co-ordination numbers and stereo-chemistry

- (a) Configurational Isomers
- (b) Conformational isomerism, VSPER theory, molecular orbital theory applied to homonuclear diatomic molecules and heteronuclear Diatomic molecules.

**Bonding in metal complexes:** Valence bond theory for co-ordinate complexes, inner and outer orbital complexes, Electro-neutrality and back bonding, limitations of V.B. theory.

**Stability of coordination compounds:** Introduction, Stability constant, stepwise stability constant, overall stability constant. Factors affecting the stability of metal ion complexes with general ligands, HSAB principle.

**UNIT-II**

**12Hrs**

**Crystal field theory:** Splitting 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. Structural effects of crystal field splitting (Jahn-Teller distortion, variation of Ionic radii with increase in atomic number). Thermodynamics effects of C.F. splitting, variation in lattice energies, Hydration energies, Dissociation energies, Formation constants of hexammines. Site selection in spinels, Paramagnetism, diamagnetism, ferro and anti ferromagnetism. Microstates and spectroscopic terms, a calculation of spectroscopic terms for  $d^1$  electronic configurations, L S coupling, Hund's rule for finding the ground state terms, Electronic spectral properties of 1st transition series, Orgel Diagrams for  $d^1 - d^{10}$  systems, for weak field octahedral and tetrahedral complexes, limitations of C.F.T

**UNIT-III**

**11Hrs**

**Molecular Orbital Theory:** Evidence for covalent character in Bonding, MOEL diagram for octahedral and tetrahedral complexes involving bonding, charge transfer transitions.

**$\pi$ Acid Ligands:** Definition Carbon monoxide complexes, bonding in linear MCO groups, polynuclear metal carbonyls, vibrational spectra, Reactions, carbonyl hydrides and halides. Metal-metal bonding metal-metal multiple bonding , isolable analogies, Structure of high nuclearity carbonyl clusters, counting of electrons in carbonyl clusters.

**UNIT-IV**

**10Hrs**

**Alkali metal and alkaline earth metal chelators:** Macroyclic ligands, macrocyclic effect, crown ethers and podands, coronands, cryptands, structure of 18 crown-6 complex with KNCS, ion cavity complex, effect of anion and cation type on complex structure, simultaneous complexation of metal ion and water or of two metal ions, sandwich formation, cryptands and their cation complexes, podands with aromatic donors and groups.

**Text and Reference Books:**

1. J.E. Huheey, Inorganic Chemistry, 3<sup>rd</sup> Ed.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry.
3. B.E. Douglas and D.H. McDaniel, Concepts and Models of Inorganic Chemistry.
4. R. Hilgenfeld and W. Saengar, Topics in current chemistry Vol-II.

*B.Sc. (Hons) Physics/Math Semester-II*  
Inorganic Chemistry Practical  
BHMH-209

**Max. Marks: 22+8 (Internal Assessment)**

**Labs 3 Hrs/week**

Identification of cations and anions in a mixture which may contain combinations of acid ions. These must contain interfering acid anions and one, the insoluble.

**a) Special Tests for Mixture of Anions**

- (i) Carbonate in the presence of sulphate.
- (ii) Nitrate in the presence of nitrite
- (iii) Nitrate in the presence of bromide and iodide.
- (iv) Nitrate in the presence of chlorate.
- (v) Chloride in the presence of bromide and iodide.
- (vi) Chloride in the presence of iodide.
- (vii) Bromide and iodide in the presence of each other and of chloride.
- (viii) Phosphate, arsenate and arsenite in the presence of each other.
- (ix) Sulphide, sulphite, thiosulphate and sulphate in the presence of each other.
- (x) Borate in the presence of copper and barium salts.
- (xi) Oxalate in the presence of fluoride.

**b) Separation and Identification of Cations in Mixtures**

- (i) Separation of cations in groups.
- (ii) Separation and identification of Group I, Group II (Group IIA and IIB), Group III, Group IV, Group V and Group VI cations.

**Book:** Vogel's book on Inorganic Qualitative Analysis