FACULTY OF SCIENCES

SYLLABUS

FOR

B.Sc. Biotech

(Semester I, III, V-VI)

Session: 2021-22

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

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

BTL105
Chemistry-I (Inorganic Chemistry)

Time: 3 Hours **Max. Marks: 40**
Periods/week: 4 **Theory: 30; Int. Ass.: 10**

Note for the paper setters/examiners:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Introduction, Werner's coordination theory, naming of co-ordinate complexes.
Co-ordination numbers 1-12. Factors affecting co-ordination numbers and stereo-chemistry, Isomerism in coordination compounds.

Section-B

Valence bond theory for co-ordinate complexes, inner and outer orbital complexes, electro-neutrality and back bonding, limitations of V.B. theory.

Section-C

Stability of co-ordination compounds
Introduction Factors affecting the stability of metal ion complexes with general ligands
Alkali metal and alkaline earth metal chelators : Definition and few examples of macrocyclic ligands, macrocyclic effect, crown ethers &cryptands.

Section-D

Crystal field theory-Spliting of d-orbitals in octahedral, tetrahedral, cubic and square planer fields of ligands, calculations of C.F.S.E. in high spin and low spin octahedral and high spin tetrahedral complexes, factors affecting the 10 Dq value.
Spectroscopic terms for d^1-d^2 electronic configurations.

Books Recommended:

1. G.L. Eichorn, Inorganic Biochemistry, Vol. I Elsevier,
2. J.E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry, 4th ed. Pearson Education, Singapore, 1999.
3. D.F.C Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, ELBS Oxford, 1991.
4.Cowan, J.A. (1997) – Inorganic Biochemistry – An Introduction, Wiley- VCH

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

BTP125

Chemistry-I (Inorganic Chemistry) Lab

Time: 3 Hours **Max. Marks: 20**

Periods/week: 4 **Practical : 15; Int. Ass.: 05**

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 KM_nO_4.

Complexometric titration using EDTA Ca^{2+},Mg^{2+}: in context with study of hardness of water.

Inorganic qualitative analysis:

Four ions (Two cations two anions).

A. Preliminary tests: Physical examination, Dry heating test, charcoal cavity test,

$Co(NO_3)_2$ test, flame test, borax bead test.

B. Acid radical analysis: metal ions

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTL203 Chemistry-II (Organic)

Time: 3 Hours **Max. Marks: 40**
Periods/week: 4 **Theory: 30; Int. Ass.: 10**

Note for the paper setters/examiners:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section–A

Reactive intermediates
Carbocations, carbanions, free radicals, carbenes, arenes and nitrenes(with examples). Assigning formal charges on intermediates and other ionic species

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

Section–B

Aromaticity
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/para ratio.Side chain reactions of benzene derivatives. Methods of formation and chemical reactions of alkylbenzenes

Section-C

Stereochemistry: Molecular chirality, enantiomers/symmetry in achiaral structures, chiral centres 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.

Section-D

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 SN2reactions, 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 SN1reactions, carbocation real arrangements in SN^1 reactions, solvent effects, subtitution and elimination as competing reactions.

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

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

BTP223 Chemistry-II (Organic) Lab

Time: 3 Hours **Max. Marks: 20**
Periods/week: 4 **Practical : 15; Int. Ass.: 05**

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.

Organic qualitative analysis:

Complete identification including derivation of following organic compounds:

- Aromatic hydrocarbons

- Aldehydes

- Ketones

- Carbohydrates

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

BT-507: Physical, Organic & Inorganic Aspects of Spectroscopy-A

Time: 3 Hrs. **Max.Marks:30+10 (Internal Assessment)**
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. Two questions 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

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

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

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

Time: 3 Hrs. **Max. Marks: 15+05 (Internal Assessment)**

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 $KMnO_4/K_2Cr_2O_7$

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BT-607: Physical, Organic & Inorganic Aspects of Spectroscopy-B

Time: 3 Hrs. **Theory : 30**
Periods: 3 **Total** **Int. assessment: 10**
Total 40

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

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.Practical : 15
Periods: 4 **Int. assessment: 05**
Total : 20

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