FACULTY OF SCIENCES

SYLLABUS FOR

Programme Name: B.Sc. Biotechnology

Academic Session: 2024-25

Department of Chemistry
Khalsa College, Amritsar

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

CH-BTL235
Chemistry-II (Organic)

L T
Credit Hours : 2+1=3
Maximum Marks: 75
Theory: 56
Internal Assessment: 19

Time: 3 Hours
Note for the paper setters/examiners:
The question paper will consist of five sections: A, B, C, D, and E. Section A is compulsory and will consist of 8 short-answer type questions covering the whole syllabus, with each question carrying 2 marks. Candidates are required to attempt six questions from this Section. Sections B, C, D, and E will have two questions from the Unit I, II, III and IV of the syllabus and carry 11 marks. Candidates are required to attempt one question each from Sections B, C, D, and E of the question paper.

Course objectives
1. Students will learn about aromatic compounds, alkanes, alkenes.
2. Stereochemistry (3D arrangement of molecules), the reactivity of carbonyl compounds with both hard and soft nucleophiles (carboxylic acids, aldehydes and ketones.

Course content

Unit I

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 chemicalbond, Van der Waals interactions, resonance, hyperconjugation, hydrogen bonding and Inductive and electrometric effects.

Unit II

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

Unit III

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 Prelog R-S notional system physical properties of enantiomers. Stereochemistry of chemical reactions that produce chiral centres, chemicalreactions 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 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 OrganicChemistry
8. E.L. Eliel, Stereochemistry of carbon compounds.
9. W. Camp, Organic Spectroscopy.
10. F. A. Carey, Organic chemistry

Course outcomes:

S. No.	On completing the course, Students will be having
CO1	Basic knowledge on the nomenclature, structure, stability and method of preparation of various reaction intermediates.
CO2	Knowledge of various field effects line Inductive, Electromeric, Resonance and Hyperconjugation along with some interactive forces.
CO3	Practice on the electrophilic substitution on the aromatic systems and information on the directive influence of various groups on these reactions.
CO4	Knowledge on some aspects of stereochemistry, Chirality, Prochirality, R-S and related topics.
CO5	Detailed knowledge of the Nucleophilic Substitution reactions SN1 and SN2 and the factors effecting these reactions.

B.Sc. BIOTECHNOLOGY (SEMESTER–III)

CH-BTP235

Chemistry-II (Organic) Lab

Time: 3 Hours
Credit Hours: 1

Maximum Marks: 25
Practical: 19
Internal Assessment: 6

Course objectives

Students will gain practical knowledge of handling chemicals.
Students will learn identification of functional groups: Aldehydes, ketones, acids, Phenols,Amines and carbohydrates

Course content

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:

1. Amides
2. Amines
3. Carboxylic acids and phenols.Organic qualitative analysis:
   Complete identification including derivation of following organic compounds:
4. Aromatic hydrocarbons
5. Aldehydes
6. Ketones
7. Carbohydrates

Course outcomes:

S. No.	On completing the course,
CO1	To perform various functional group tests in identification of organic compounds Such as phenols, carboxylic acids, carbonyl compounds, carbohydrates etc.
CO2	Systematic qualitative analysis of organic compounds for the detection of elements
CO3	Identification of the compounds and preparation of derivative and determination of its melting point.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BTL355 Chemistry-III (Physical)

Credits: 3 Hrs/week

Total Hours: 45
Maximum Marks: 40
Theory: 30
Internal Assessment: 10

Time: 3 Hours
Instructions for the Paper Setters:
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.

Course objectives:
The main aim of the course is to familiarize the students to few major areas of Physical Chemistry ie Thermodynamics, Solution Chemistry, Electrochemistry, Chemical Kinetics and Catalysis as these fields find wide applications in large number of industrialventures.

Course contents:

Section-A

CHEMICAL THERMODYNAMICS:
Objectives and limitations of Chemical Thermodynamics, State functions, thermodynamic equilibrium, work, heat, internal energy, enthalpy. First Law of Thermodynamics : First law of thermodynamics for open, closed and isolated systems. Reversible isothermal and adiabatic expansion/compression of an ideal gas. Irreversible isothermal and adiabatic expansion. Enthalpy change and its measurement, standard heats of formation and absolute enthalpies. Kirchoff□s equation. Second and Third Law: Various statements of the second law of thermodynamics. Efficiency of a cyclic process (Carnot□s cycle).Entropy. Entropy changes of an ideal gas with changes in P,V, and T. Free energy and work functions. Gibbs-Helmholtz Equation. Criteria of spontaneity in terms of changes in free energy. Third law of thermodynamics: Absolute entropies. Thermodynamics of Simple Mixtures: Partial molarquantities and their significance. Chemical potential and its variation with T and P. Fugacity function and its physical significance. Concept of activity and activity coefficient.

Section-B

SOLUTIONS:

Ideal and non- ideal solutions, method of expression concentrations of solution, activity and activity coefficients, dilute solution, Osmotic pressure, its law and measurements, Elevation of boiling point and depression of freezing points. Chemical Equilibrium : General characteristicsof chemical equilibrium, thermodynamic derivation of the law of chemical equilibrium, Van□t Hoff reaction isotherm. Relation between Kp, Kc and Kx. Temperature dependence of equilibrium constant Van□t Hoff equation, homogeneous & heterogreneous equilibria, Le Chetalier□s principle.

Section-C

CHEMICAL KINETICS AND CATALYSIS: Scope, rate of reaction, influencing factors such as concentration, temperature, pressure, solvent etc. theories of chemical kinetics. Arrhenius equation, concept of activation energy. Rates of reactions, rate constant, order and molecularity of reactions. Chemical Kinetics: Differential rate law and integrated rate expressions for zero, first, second and third order reactions. Half-life time of a reaction. Methods for determining order of reaction. Effect of temperature on reaction rate and the concept of activation energy. Reaction mechanism. Steady state hypothesis. Catalysis : Homogeneous catalysis, Acid-base catalysis and enzyme catalysis (Michaelis-Mentenequation). Heterogeneous catalysis. Unimolecular surface reactions.

Section-D

ELECTRO-CHEMISTRY: Specific conductance, molar conductance and their dependence on electrolyte concentration. Ionic Equilibria and conductance, Essential postulates of the Debye-Huckel theory of strong electrolytes. Mean ionic activity coefficient and ionic strength.Transport number and its relation to ionic conductance and ionic mobility. Conductometric titrations. pH scale. Buffer solutions, salt hydrolysis.Acid-base indicators.

Books Recommended

1 Physical Chemistry by Peter Atkius 10th edition.
2 Thermodynamics for chemists by Samuel Glasstone 2009
3 Chemical Kinetics by Keith J. Laidler 10th edition.
4 Modern Electrochemistry by John O□M Backris and K.N. Reddy 10th edition.

Course outcomes:

Sr. No.	On completing the course,
CO1	Students will able to understand the Laws of Thermodynamics and its applications on the chemical systems.
CO2	Students will be having the knowledge of Solution Chemistry, Chemical equilibrium and its applications.
CO3	Students will learn about Chemical kinetics, homogeneous catalysis, autocatalysis, and oscillation reactions. Enzyme catalysis and heterogeneous catalysis

CO4	Students will be having knowledge on the advance topics of Electrochemistry and its application in constructions of cells, batteries, analytical techniques etc.

B.Sc. (BIO-TECHNOLOGY) (SEMESTER–VI)

BTP375 Chemistry-III (Physical) Lab

Credits: 3 Hrs/week
Total Hours: 45
Maximum Marks: 20
Practical: 15
Internal Assessment: 5

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

Course objectives

Students will gain the practical knowledge of handling chemicals and some lab instruments. Students will learn some physical techniques of quantitative analysis like calorimetry, conductometry, Photometry, pH-metry and Polarimetry as these techniques find wide applications in various industries.

Course content

1. 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

2. Conductometry:

a. Determination of cell constant.

b. Determination of specific and equivalent conductance of electrolyte (NaCl andHCl).

c. Precipitation titration of Na_2SO_4 vs. $BaCl_2$.

d. Neutralization titrations NaOH vs. HCl and NaOH vs. CH_3COOH.

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

a) Acid base titration HCl vs. NaOH.

b) Determination of ionization constant of a weak acid (CH_3COOH)

5. Determine composition of HCl and CH_3COOH in the given solution pH metrically.

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

Books Recommended

1 Findlay□s Practical Physical Chemistry, 9th Edition, Revised by B.P. Levitt
2 Experimental Physical Chemistry by RC DAS and B. Behera 9th Edition,

Course outcomes

S. No.	On completing the course,
CO1	Students will learn to calibrate the conductivity meter, operate and obtain conductance values from various solutions
CO2	Learn to carry out quantitative analysis using pH titration.
CO3	Student will be able to find the enthalpies of neutralization, solution etc.calorimetrically.
CO4	Quantitatively measure the composition using Polarimeter.
CO5	Trouble shoot instrument related or solution related issues.