SCHEME OF EXAMINATION

AND

COURSE OF STUDY

NEP-2020

B. Sc. (CHEMISTRY)

(w.e.f. 2022-2023)

DEPARTMENT OF CHEMISTRY

GURUKUL KANGRI (DEEMED TO BE UNIVERSITY), HARIDWAR

27 May, 2022

PROGRAM OUTCOMES OF B.SC. COURSE IN CHEMISTRY

Following Program outcomes are mapped with Course Outcomes in Each course.

PO1. To develop interest among students for chemistry and its application in various fields.

PO2. To help students in attaining basic concepts with balanced knowledge of chemistry.

PO3. To develop and enhance the practical chemistry skills among students.

PO4. To create awareness about nature, society and market with respect to environment, chemicals and pollutants in students.

PO5. To build confidence among students in solving research problems independently.

PO6. To link student's chemical knowledge with Vedic chemistry.

PO7. To encourage students with skills towards employment or higher education in multidisciplinary areas.

PO8. To upgrade student's knowledge about analysis of industrial products for better industrial employment

Course Title– DSC : Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons **w.e.f. the session 2022-23 and onwards**	
Class: B.Sc. Pt.-I / Semester-I	Course code: BCH-C101
Lecture: 60	Credits: 04
MM: 70	Exam Hrs: 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

Section A: Inorganic Chemistry-1 **(30 Periods)**

Note: Review part is for refreshing the student about the basic concept, No question should be asked from this portion.

AtomicStructure:*Review of: Bohr's theory and its limitations,dual behaviour of matter andradiation,de-Broglie'srelation,HeisenbergUncertaintyprinciple.Hydrogenatom spectra. Need of a new approach to Atomic structure.*

Quantum mechanics. Meaning of various terms in & Significance of ψ and ψ^2 in Schrödinger equation for hydrogen atom (excluding derivation). Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers,orbital angular momentum and quantum numbers m_l and m_s. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (m_s).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

(14 Lectures)

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan'srules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods(including idea of *s-p* mixing) and heteronuclear

diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.

(16 Lectures)

Section B: Organic Chemistry-1 **(30 Periods)**

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, ElectromericEffect, Resonance and Hyperconjugation. Cleavage of Bonds:Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Aromaticity: Benzenoids and Hückel's rule. **(8 Lectures)**

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). D and L; *cis* - *trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). **(10 Lectures)**

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 3 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Upto 3 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff'srule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti- Markownikoff's addition), Hydration, Ozonolysis.

Alkynes: (Upto 3 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal- dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$.

(12 Lectures)

Reference Books:

1. J. D. Lee: *A new Concise Inorganic Chemistry*, EL. B. S.
2. F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
3. Douglas,McDanielandAlexader:*ConceptsandModelsinInorganicChemistry*, John Wiley.
4. James E. Huheey, *Ellen Keiterand Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
5. T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons*.
6. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient
    a. Longman.
7. E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
8. I.L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
9. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
10. ArunBahland B. S. Bahl: *Advanced Organic Chemistry,* S. Chand

Puri, Sharma, Kalia, Principles of Inorganic chemistry, Vishal Publications.

Course Objectives

1. To understand the basic concepts of atomic structure and chemical bonding.
2. To understand the general organic chemistry, stereochemistry and chemistry of alkanes, alkenes and alkynes.

Course Outcomes (Cos)

After the completion of this course, a student should be able to:

CO:1 Understand the basic idea of quantum mechanics for atomic structure, quantum numbers and rules for filling electrons in various orbitals.

CO:2 Explain different types of chemical bonding VBT, MOT, VSEPR theories for understanding the nature of bonding.

CO:3 Explain the various phenomenons in organic molecules, their effect and nature of organic reactions through reactive intermediates.

CO:4 Understand the stereochemical behavior of simple organic molecules and their applications in natural system.

CO:5 Idea of synthesis and properties of commercially important alkanes, alkenes and alkynes.

Course Outcomes (Cos) / Program Outcomes (Pos)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1		X			X			X
CO:2	X			X		X		X
CO:3		X	X					
CO:4		X		X		X		
CO:5	X			X				X

Note: put ‘X’ in relevant column of mapping

Course Title: Lab Course I***, w.e.f. the session 2022-23 and onwards***	
Class B.Sc: Pt.I / SEM I	COURSE CODE: BCH-C 151
Laboratory Periods: 60	Credits: 02
MM: 70	Exam Hrs: 04

Course Contents:

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

2. Estimation of oxalic acid by titrating it with $KMnO_4$.

3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$using internal indicator.

5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry

1.Detectionofextraelements(N,S,Cl,Br,I)inorganiccompounds(containingupto two extraelements)

2. Separation of mixtures by Chromatography: Measure the Rf value in each case
(combination of two compounds to be given)

(a)Identifyandseparatethecomponentsofagivenmixtureof2aminoacids(glycine, asparticacid, glutamicacid, tyrosine or any other amino acid) by paper chromatography

(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Distribution of Marks:

Experiment 1: 25 Marks

Experiment 2: 25 Marks

Practical Record: 10 Marks

Viva-voce: 10 Marks

Reference Books:

- Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
- Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
- Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5th edition.
- Practical Organic Chemistry, F. G. Mann. &B. C. Saunders, Orient Longman, 1960.

COURSE TITLE: DSC -CHEMISTRY: Chemical Energetics, Equilibria& Functional Organic Chemistry, **w.e.f. the session 2022-23 and onwards**	
Class B.Sc: Pt.I / SEM II	COURSE CODE: BCH-C 201
Lecture: 60	Credits: 04
MM: 70	Exam Hrs: 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Section A: Physical Chemistry-1 **(30 Lectures)**

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics.
Importantprinciplesanddefinitionsofthermochemistry.Conceptofstandardstateand standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy ofa reaction with temperature– Kirchhoff's equation.
Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

(10 Lectures)

Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG andΔG^{O}, Le Chatelier'sprinciple. Relationships between K_p, $K_C$and$K_X$for reactions involving ideal gases.

(8 Lectures)

Ionic Equilibria:
Strong,moderateandweakelectrolytes,degreeofionization,factorsaffectingdegreeof ionization,ionizationconstantandionicproductofwater.Ionizationofweakacidsand bases, pHscale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degreeofhydrolysisandpHfordifferentsalts.Buffersolutions.Solubilityandsolubility product of sparingly soluble salts – applications of solubility product principle.

(12 Lectures)

Section B: Organic Chemistry-2 **(30 Lectures)**
Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons
Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.
Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto4 carbons on benzene). Sidechain oxidation of alkyl benzenes (upto 3 carbons on benzene).

(8 Lectures)

Alkyl and Aryl Halides
Alkyl Halides (Upto 3 Carbons) Types of Nucleophilic Substitution reactions.

Preparation: from alkenes *and* alcohols.
Reactions: hydrolysis, nitrite & nitro formation, . Williamson's ether synthesis: Elimination vs substitution.
Aryl Halides *Preparation:* (Chloro, bromoand iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.
Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3(or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

(8 Lectures)

Alcohols, Phenols and Ethers (Upto 3 Carbons)

Alcohols: *Preparation:*Preparation of1^o, $2^o$and 3^oalcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylicacid and esters.
Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc.HNO_3).Oppeneauer oxidation , Pinacol-Pinacolone rearrangement.
Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Schotten – Baumann Reaction.
Aldehydes and ketones (aliphatic and aromatic):(Formaldehye, acetaldehyde, acetone and benzaldehyde)
Preparation: from acid chlorides and from nitriles.
Reactions –Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodo form test. Aldol Condensation, Cannizzaro'sreaction, Clemensen reduction and Wolff Kishner reduction. **(14 Lectures)**

Reference Books:

- T. W. GrahamSolomons: *Organic Chemistry, John Wiley and Sons*.
- Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
- I.L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
- R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
- ArunBahland B. S. Bahl: *Advanced Organic Chemistry,* S. Chand.
- G. M. Barrow: *Physical Chemistry* Tata McGraw-Hill (2007).
- G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
- J.C.Kotz,P.M.Treichel&J.R.Townsend:*General Chemistry*CengageLening IndiaPvt.Ltd., New Delhi (2009).
- B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
- R.H.Petrucci:*GeneralChemistry*5thEd.MacmillanPublishingCo.:NewYork (1985).

Course objective

1.To enable students to identify a problem the thermodynamic laws and thermochemistry reaction
2. To understand the laws of chemical equilibrium
3. To learn student general organic chemistry
4. To understand the basic name reaction in organic chemistry

Course outcomes (Cos)

CO:1 Understand the student about the thermodynamic laws and thermochemistry reaction

CO:2Explain the chemical reaction equilibrium and mass law about information

CO:3Determinations of ionic equilibrium and pH. salt hydrolysis, buffer solution and differencing ionic reaction

CO:4 About Understanding the aromatic hydrocarbon and general organic chemistry

CO:5Give information about the aryl halide and alkyl halide compound
CO:6Understand the alcohol, phenol and aldehyde- ketone reactions in organic chemistry

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO:1		X			X			X
CO:2				X		X		X
CO:3	X		X					
CO:4		X		X				
CO:5	X			X				X
CO:6	X				X		X	

Note: put ‘X’in relevant column of the mapping

Course Title: Lab Course II***, w.e.f. the session 2022-23 and onwards***	
Class B.Sc: Pt.I / SEM II	COURSE CODE: BCH-C 251
Laboratory Periods: 60	Credits: 02
MM: 70	Exam Hrs: 04

Course Contents: Experiments

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoicacid in water and determination of ΔH.

Ionicequilibria

pH measurements

a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH strips.

b) Preparation of buffer solutions:

(i) Sodiumacetate-aceticacid

(ii) Ammoniumchloride-ammonium hydroxide

MeasurementofthepHofbuffersolutionsandcomparisonofthevalueswiththeoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting pointand calculation of quantitative yields to be done.

(a) Bromination of Aniline

(b)Benzoylation of amines/phenols

(c) Oximeand 2,4 dinitrophenylhydrazone of aldehyde/ketone

Distribution of Marks:

Experiment 1: 25 Marks
Experiment 2: 25 Marks
Practical Record: 10 Marks
Viva-voce: 10 Marks

Reference Books

- A.I. Vogel:Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
- F. G. Mann &B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
- B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

Course Title: Name of course: DSC- Solutions, Phase Equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry-II ***w.e.f. the session 2023-24 and onwards***	
Class: B.Sc. Pt.-II / Semester-III	Course code: BCH-C301
Lectures: 60	Credits:04
MM: 70	Exam Hrs: 03

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Section A: Physical Chemistry-2 **(30 Lectures)**

Solutions

Thermodynamics of ideal solutions: Ideal solutions and Raoult'slaw, deviations from Raoult'slaw – non-ideal solutions. Vapour pressure-composition and temperature- compositioncurvesofidealandnon-idealsolutions.Distillationofsolutions.Leverrule. Azeotropes.

Partialmiscibilityofliquids:Criticalsolutiontemperature;effectofimpurityonpartial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

Phase Equilibrium

Phases,componentsanddegreesoffreedomofasystem,criteriaofphaseequilibrium.

GibbsPhaseRuleanditsthermodynamicderivation.DerivationofClausius–Clapeyronequation and its importance in phase equilibria. Phase diagrams of one-component systems(waterandsulphur)andtwocomponentsystemsinvolvingeutectics,congruent and incongruent melting points (lead-silver, KI-H_2O and Na-K only).

Conductance

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility productsofsparinglysolublesalts,ionicproductofwater,hydrolysisconstantofasalt. Conductometric titrations (only acid-base).

Electrochemistry

Reversibleandirreversiblecells.ConceptofEMFofacell.MeasurementofEMFofa cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data.

Calculation of equilibrium constant from EMF data. Concentration cells without transference. Liquid junction potential and salt bridge.

pH determination using hydrogen electrode and quinhydrone electrode.

Potentiometric titrations –qualitative treatment (acid-base and oxidation-reduction only).

Section B: Organic Chemistry-3 **(30 Lectures)**

Functional group approach for the following reactions (preparations &reactions) to be studied in context to their structure.

Mono Carboxylic acids (aliphatic and aromatic)

Preparation: Acidic and Alkaline hydrolysis of esters.
Reactions: Hell – Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 3 carbons)
Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion.
Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Amines and Diazonium Salts

Aliphatic Amines (Upto 4 carbons), Aromatic Amines
Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.
Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2,Schotten–BaumannReaction.Electrophilicsubstitution(caseaniline):nitration, bromination, sulphonation.

Benzene Diazonium salts: *Preparation:* from aromatic amines.
Reactions: conversion to benzene, phenol, dyes.

Amino Acids, Peptides and Proteins:
Preparation of AminoAcids: Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.
Reactions of Amino acids: ester of –COOH group, acetylation of $–NH_2$group, complexation with Cu^{2+}ions, ninhydrin test.
Overview of Primary and Secondary Structure of proteins.
Introduction to peptide & polypeptide, relationship with proteins.

Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Mutarotation, Osazone formation. Drawing the Structure only of disacharrides (sucrose, cellobiose and maltose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Recommended Books/References (Depends on paper)

- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
- Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry*, 5th Ed., Macmillan Publishing Co.: New York (1985).
- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Bioch*emistry *7th Ed.*, W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. &Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

Course Objectives
1. To Learn various theories of physical chemistry
2. Understand the concept of organic reaction and various method for synthesis of Carboxylic acid, amines, Amino Acids, Peptides Proteins and Carbohydrates

Course Outcomes (COs)
CO:1 Describe the Raoult'slaw for Ideal and non-ideal Solution, Immiscibility of liquids-

Principle of steam distillation. Nernst distribution law and its applications
CO:2Solve the Clausius–Clapeyron equation and its importance in phase equilibria, Solve one-component systems and two component system
CO:3Explain the concept of Conductance, molar conductivity, Kohlrausch law, Transference number, Solubility and solubility products and hydrolysis
CO:4Able to describe Reversible and irreversible cells, EMF, Nernst equation, thermodynamic properties and pH determination using hydrogen electrode and quinhydrone electrode
CO:5Acquire Knowledge about synthesis and reaction of Carboxylic acid derivatives
CO:6To understand the concept of amines and benzene diazonium salts: Synthesis and its role in various organic conversion

CO:7Various process for Amino Acids, Peptides and Proteins
CO: 8 Different type of Carbohydrates: structure and Mutarotation

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO:1	X		X				X	X
CO: 2		X	X				X	
CO: 3	X		X		X			X
CO: 4	X		X	X	X		X	
CO: 5		X	X				X	X
CO: 6	X	X	X				X	
CO: 7		X	X				X	X
CO: 8	X		X		X		X	X

Note: put ‘X’in relevant column of mapping

Course title: SEC- Chemical Technology and Society ***w.e.f. the session 2023-24 and onwards***	
Class: B.Sc. Pt.-II / Semester-III	Course code: BCH-S-301
Lectures: 30	Credits: 04
MM:70	Exam Hrs:03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

Chemical Technology

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types ofequipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry.Introduction to clean technology.

Society

Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants); energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues. Effect of pollution on society.

Reference Book:

JohnW.Hill,TerryW.McCreary&DorisK.Kolb,*Chemistryforchangingtimes*13th Ed.

Course Objectives:

1. To deliver the knowledge on the various separation techniques viz. distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption, adsorption and their uses.
2. To impart the knowledge on the use of various clean technologies.
3. To provide brief knowledge to students about some equipment's used in industries.
4. To develop scientific literacy among the students.
5. To impart the knowledge about the various kind of pollution and their adverse effects on the society.
6. To provide an understanding of the importance of the renewable energy sources.

Course Outcomes (COs):

CO1. Students shall be able to understand the different type of separation techniques and their uses so that they will be able to choose the appropriate technique according to their applications.
CO2. The students will understand the working principles of various equipments used in the chemical industries including reactors, distillation columns, extruders, pumps, mills.
CO3. Students when approaching the chemical industry will be able to know the seriousness of handling these equipments.
CO4. Awareness about scientific literacy will be there among students.
CO5. The importance of the renewable energy sources in the current time will also be understood by the students so that they can be able to aware the society about this fold of energy.

CO6. Awareness to minimize the pollution and its causes can be distributed into the society by the students after studying the course.

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO1	X			X			X	X
CO2	X			X				X
CO3				X			X	X
CO4				X				X
CO5				X				
CO6				X				

Note: put ‘X’ in relevant column of mapping

Course Title**:** Lab Course II***, w.e.f. the session 2023-24 and onwards***	
Class B.Sc: Pt.I I/ SEM III	COURSE CODE: BCH-C 351
Laboratory Periods: 60	Credits: 02
MM: 70	Exam Hrs: 04

Course Contents: Experiments

Section A: Physical Chemistry

Distribution

Study of theequilibrium of one of the following reactions by the distribution method:

$I_2(aq) + I^-(aq) \rightleftharpoons I_3^-(aq)$

$Cu^{2+}(aq) + xNH_2(aq) \rightleftharpoons [Cu(NH_3)_x]^{2+}$

Phaseequilibria

a)Constructionofthephasediagramofabinarysystem(simpleeutectic)using cooling curves.

b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.

c)Studyofthevariationofmutualsolubilitytemperaturewithconcentrationfor the phenol water system and determination of the critical solubility temperature.

Section B: Organic Chemistry

I Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctionalgroups(-COOH,phenolic,aldehydic,ketonic,amide,nitro,amines)and preparation of one derivative.

II

1. Separation of amino acids by paper chromatography
2. Determination of the concentration of glycine solution by formylation method.
3. Titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. Differentiation between a reducing/non reducing sugar.

Distribution of Marks:

Experiment 1: 25 Marks
Experiment 2: 25 Marks
Practical Record: 10 Marks
Viva-voce: 10 Marks

Reference Books:

- A.I. Vogel:Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
- F. G. Mann &B. C. Saunders: Practical Organic Chemistry, Orient Longman, 1960.
- B.D. Khosla: Senior Practical Physical Chemistry, R. Chand & Co.
- Ahluwalia, V.K. &Aggarwal, R. *ComprehensivePracticalOrganicChemistry*, Universities Press.

COURSE TITLE-**DSC:** COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS ***w.e.f. the session 2023-24 and onwards***	
Class B.Sc : PT.II / SEM IV	COURSE CODE : BCH-C401
Lecture: 60	Credit : 04
MM: 70	Exam Hr : 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questionsfrom the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Section A: Inorganic Chemistry **(30 Lectures)**

***1. s*- and p- Block Elements**

Screening effect, Slater rule, effective nuclear charge. Periodicity in*s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron affinity, electronegativity (Pauling, Mulliken, and Alfred- Rochow scales). Allotropy in C, S, and P.

Oxidation stateswith reference to elements in unusual and rare oxidation states like carbidesandnitrides),inertpaireffect,diagonalrelationshipandanomalousbehaviourof firstmember of each group.(10 lecture)

2. Transition Elements (3d series)

Transition Elements (3d series) General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

(10 lecture)

3. Coordination Chemistry

Coordination Chemistry Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). IUPAC system of nomenclature.

Crystal Field Theory Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

(10 lecture)

Section B: Physical Chemistry-3 **(30 Lectures)**

4 Kinetic Theory of Gases

Postulates of KineticTheory of Gases and derivation of the kinetic gas equation.

Deviationofrealgasesfromidealbehaviour,compressibilityfactor,causesofdeviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required).Criticalphenomena,criticalconstantsandtheircalculationfromvanderWaals equation. Andrews isotherms of CO_2.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no

derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules.

5.Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determinationofcoefficientofviscosityusingOstwaldviscometer.Effectoftemperature on surfacetensionand coefficient of viscosity of aliquid (qualitative treatment only)

6.Solids

Formsofsolids.Symmetryelements,unitcells,crystalsystems,Bravaislatticetypesand identificationoflatticeplanes.LawsofCrystallography-Lawofconstancyofinterfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law.Structures of NaCl, KCl and CsCl (qualitative treatment only).

7.ChemicalKinetics

Theconceptofreactionrates.Effectoftemperature,pressure,catalystandotherfactors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Reference Books:

- G. M. Barrow: *Physical Chemistry* Tata McGraw-Hill (2007).
- G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
- J.C.Kotz,P.M.Treichel&J.R.Townsend:*GeneralChemistry*CengageLening India Pvt. Ltd., New Delhi (2009).
- B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
- R.H.Petrucci:*GeneralChemistry*5thEd.MacmillanPublishingCo.:NewYork (1985).
- J. D. Lee: *A New Concise Inorganic Chemistry,* E.L.B.S.
- F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry,* John Wiley.
- D. F. Shriver and P. W. Atkins: *Inorganic Chemistry,* OxfordUniversity Press.
- Gary Wulfsberg: *Inorganic Chemistry,* Viva Books Pvt. Ltd.

Course objectives

1.To enable student to identify a problem transition metal
2.Understanding of student's coordination chemistry
3.To understanding of students matters solid, liquid and gases state
4. Understand of students' kinetics studies molecular reaction

Course out comes (COs)

CO:1 Helped students in attaining basic concepts with a balanced knowledge of *s*- and p- Block Elements
CO:2 Created awareness about Transition Elements (3d series)
CO:3 Developed interest among students for Coordination Chemistryand its application
CO:4 Upgrade students' knowledge about basic concepts of Kinetic Theory of Gases.
CO:5 Developed and enhanced knowledge about the introduction Understanding the viscosity and surface tension values, as well as the elements that influence and apply to liquids
CO:6 Created awareness about thesolid state structure.
CO:7 Created the understand chemical kinetics investigations for molecule and concept research
CO:8 Created chemical knowledge in chemical kinetics

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO:1	X				X			X
CO:2				X				X
CO:3	X		X					
CO:4		X		X			X	
CO:5				X				X
CO:6	X				X			
CO:7		X	X				X	
CO:8						X		

Note: put ‘X’in relevant column of the mapping

Course Title: Chemistry-SEC: **BUSINESS SKILLS FOR CHEMISTS** ***w.e.f. the session 2023-24 and onwards***	
Class: B.Sc. Pt.-II / Semester-IV	Course code: BCH-S401
Lectures30	Credits:04
MM : 70	Exam. Hrs.: 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

Business Basics **(**Lectures: 06)

Key business concepts, Business plans, Market need, Project management, Routes to market, Concept of entrepreneurship

Chemistry in industry (Lectures: 06)

Current challenges and opportunities for the chemistry-based industries.
Role of chemistry in India and global economies. concept of Green Economy
Chemistry based products in the market.

Finance and Case Studies (Lectures: 06)

•Basic idea of key terms and concepts of finance
• Financial aspects of business
• Financial Case study of Successful business ideas in chemistry

Intellectual property (Lectures: 06)

Concept of intellectual property, illustration of types of intellectual property with example, meaning of inventor ship and ownership.

References

1. www.rsc.org
2. Nwaeke, L.I.(2002),Business Concepts and Perspectives, Springfield Publishers.
3. Silva, T. D. (2013), Essential Management Skills for Pharmacy and Business Managers, CRC Press.

Course Objectives

1.To enhance the business and entrepreneurial skills of chemistry students and improve their employment prospects.
2.To orient the students to understand the industry - chemistry relationship, challenges and business opportunities.
3. Course will expose the students to the concepts of intellectual property rights, patents and commercialization of innovations.
4. It will enhance the ability of project Management

Course Outcomes:

By the end of this course, students will be able to:
CO:1 Understand the process of business planning and its structure
CO:2 Factors affecting Business plan
CO:3 SWOT analysis for capabilities assessment
CO:4 Learn basics skills of business and project management.
CO:5 Financial aspects of business with its main points
CO:6 Basics of Project Management
CO:7 How to protect ideas and innovations.
CO:8 Scope of Chemistry in daily life and in Industry.

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1	X							X
CO:2	X	X		X				X
CO:3								
CO:4	X				X		X	
CO:5	X	X	X	X	X			
CO:6								
CO:7		X						
CO:8		X	X					X

Put ‘X’ in relevant column

Course Title**:** Lab Course IV***, w.e.f. the session 2023-24 and onwards***	
Class B.Sc: Pt.I I/ SEM IV	COURSE CODE: BCH-C 451
Laboratory Periods: 60	Credits: 02
MM: 70	Exam Hrs: 04

Course Contents: Experiments

Section A: Inorganic Chemistry

Semi-microqualitativeanalysisusingH_2Sofmixtures-notmorethanfourionicspecies (two anions and two cations and excluding insoluble salts) out of the following:

Cations:NH_4^+,Pb^{2+},Ag^+,Bi^{3+},Cu^{2+},Cd^{2+},Sn^{2+},Fe^{3+},Al^{3+},Co^{2+},Cr^{3+},Ni^{2+},Mn^{2+},Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+

Anions : CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-,SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^-

(Spottests should be carried out wherever feasible)

Section B: Physical Chemistry

(I) Surface tension measurement (use of organic solvents excluded).

a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

b) Study of the variation of surface tension of a detergent solution with concentration.

c) Determination of percentage composition of Alcohol water mixture by using stalagmometer

(II) Viscosity measurement (use of organic solvents excluded).

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

b)Studyofthevariationofviscosityofanaqueoussolutionwithconcentrationof solute.

c) Determination of percentage composition of Alcohol water mixture by using Ostwald's viscometer

(III) Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method:Hydrolysis of Ester
2. Integrated rate method:
   a. Acid hydrolysis of ethylacetate with hydrochloric acid.
   b. Saponification of ethylacetate.
   c. Compare the strengths of HCl and $H_2SO_4$by studying kinetics of hydrolysis of methylacetate.

Reference Books:

- A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

Course Title: Chemistry -SEC: Analytical Clinical Biochemistry ***w.e.f. the session 2023-24 and onwards***	
Class: B.Sc. Pt.-II / Semester-IV	Course code: BCH-S401
Lectures: Theory: 30+Laboratory periods:60	Credits:04(02+02)
MM : 70	Exam. Hrs.: 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

Metabolism (Lectures: 04)

Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of Energy (ATP)

Proteins (Lectures: 06)

Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins: α-helix and β- pleated sheets, Isolation, characterization, denaturation of proteins.

Enzymes (Lectures: 06)

Nomenclature, classification, Characterisation, Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions,

Introduction to biocatalysis: Importance in -green chemistry and chemical industry.

Lipids (Lectures: 06)

Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipoproteins, Properties, functions

Nucleic Acids (Lectures: 07)

Components of nucleic acids: adenine, guanine, thymine and cytosine (structure only), other components of nucleic acids, nucleosides and nucleotides (numbering), structure of DNA (Watson-Crick model)

Biochemistry of disease (Lectures: 07)

Biochemistry of disease: A diagnostic approach by blood analysis.

Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.

Practicals

1. Carbohydrates – qualitativeTests.
2. Lipids – qualitative Tests
3. Proteins – qualitativeTests
4. Determination of the saponification number of oil.
5. Determination of acid value of fats and oils.
6. Determination of the iodine number of oil.
7. Determination of cholesterol using Liebermann- Burchard reaction.
8. Determination of protein by the Biuret reaction.

Reference

Theory:

•Devlin, T.M. (2010),Textbook of Biochemistry with Clinical Correlation, Wiley.

•Berg, J. M.; Tymoczko, J. L.; Stryer, L. (2002),Biochemistry, W. H. Freeman.

•Satyanarayana, U.; Chakrapani, U. (2017),Fundamentals of Biochemistry, Books and Allied (P) Ltd.

•Lehninger, A.L; Nelson, D.L; Cox, M.M. (2009),Principles of Biochemistry, W. H. Freeman.

•Finar, I. L. Organic Chemistry (Volume 1 & 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Practical:

•Dean, J.R.; Jones, A.M.; Holmes, D;, Reed, R.; Jones, A.Weyers, J. (2011),Practical skills in chemistry, Prentice-Hall.

•Wilson, K.; Walker, J. (2000),Principles and techniques of practical biochemistry,Cambridge University Press.

•Gowenlock. A.H. (1988),Varley's Practical Clinical Biochemistry, CRC Press.

Course Objectives

1.To deliver information about biochemically significant features of the Carbohydrates, proteins,enzymes,nucleicacidsandlipids,usingsuitableexamples

2.Above willincludesclassification,properties and biological importance of biomolecules

2.Course will introduce the students the concept of genetic code and concept of heredity.

3.Understanding the basic principles that govern the biological functions of biomolecules.

Course Outcomes (COs)

By the end of this course, students will be able to:

CO:1 Well understanding with the structure of biomolecules, their reactivity and biological uses.

CO:2 To the point knowledge of concept of heredity through biological processes like replication, transcription and translation.

CO:3 Systematic knowledge of enzymes and their role in biological systems

CO:4 Students gain the knowledge of Lipids, Cholesterol and steroid Hormones

CO:5 Demonstrate an understanding of the biochemistry of diseases

CO:6 Understand the application of chemistry in analysis of biological samples especially blood and Urine.

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1	X	X						
CO:2	X	X	X	X		X		
CO:3			X					
CO:4	X				X		X	X
CO:5		X					X	X
CO:6								X

Put ‘X’ in relevant column of mapping

Course Title: DSE: Industrial Chemicals And Environment ***w.e.f. the session 2024-25 and onwards***	
Class: B.Sc. Pt.-III / Semester-V	Course code: BCH-E501
Lectures 60	Credits: 04
MM: 70	Exam Hrs.:03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

Industrial Gases and Inorganic Chemicals

Industrial Gases: Hazards and safety measures in Large scale production (excluding manufacturing process), uses, storage of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Inorganic Chemicals: Hazards and safety measures(excluding manufacturing process.) in the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thio-sulphate, hydrogen peroxide, potash alum, potassium dichromate and potassium permanganate.

(15 Lectures)

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulfur.

Air Pollution: Chemical and photochemical reactions in the atmosphere.

Air pollutants: types, sources, particle size and chemical nature; Dust, Smoke and particulates, smog and its constituents. Environmental effects of ozone.

Pollution by SO_2, CO_2, CO, NO_X, H_2S and other foul smelling gases. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens. **(20 Lectures)**

***Water Pollution*:** Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

Water purification methods. Effluent treatment plants (primary and secondary treatment).

Industrial waste management, Water quality parameters for waste water, industrial water and domestic water.

(15 Lectures)

Energy & Environment

Sources of Energy: Coal, petrol and natural gas. Nuclear Fusion/Fission, Solar energy, Hydrogen, etc.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

(10 Lectures)

Recommended Books/References (Depends on paper)

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis HorwoodLtd. UK.
2. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi
3. J. A. Kent:Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
4. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
5. K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi
7. S.E. Manahan, Environmental Chemistry, CRC Press (2005).
8. G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).
9. A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).

Course Objectives

In this course, students should be able to:

1. To understand the hazards and safety measures in large-scale production, uses and storage of industrial gases and inorganic chemicals.
2. To studies in detail about the various techniques for measuring water pollution and water purification methods.
3. To understand the aspects of the ecosystem, effects of air pollution on biodiversity and the instrumental techniques used for estimation of COx, SOx and NOx.
4. To studies on nuclear fusion and fission, solar energy and the disposal and management of nuclear waste.

Course Outcomes (COs)

On successful completion of the course with industrial chemicals and environment, the student will be able to:

CO:1 Helped students in attaining basic concepts with a balanced knowledge of fission and fusion.

CO:2 Created awareness about hazards and safety measures in the production and handling of industrial gases and inorganic chemicals for better industrial employment.

CO:3 Developed interest among students for chemistry and its application in various measurements and monitoring techniques of air pollution.

CO:4 Upgrade students' knowledge about basic concepts of water pollution and various methods of water purifications. Educated in various measurements and monitoring techniques of industrial waste management for better industrial employment.

CO:5 Developed and enhanced knowledge about the nuclear disaster and skills for its management.

CO:6 Created awareness about the effects of air pollution on biodiversity.

CO:7 Created the skill in students for better employment in environment monitoring laboratories.

CO:8 Created chemical knowledge in Vedic chemistry with hazardous chemicals and air pollution

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO:1		X						X
CO:2				X				X
CO:3	X		X					
CO:4				X				X
CO:5				X			X	
CO:6			X	X	X			
CO:7			X				X	
CO:8						X		

Note: put 'X'in relevant column of mapping

Course Title – **DSE:** Organometallics, bioinorganic chemistry, polynuclear hydrocarbons and UV, IR spectroscopy ***w.e.f. the session 2024-25 and onwards***	
Class: B.Sc. Pt.-III / Semester-V	Course code: BCH-E501
Lecture: 60	Credits: 04
MM: 70	Exam Hrs: 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

Section A: Inorganic Chemistry-4 **(30 Lectures)**

Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties);

Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside.

(6 Lectures)

Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).

(12 Lectures)

Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

(12 Lectures)

Section B: Organic Chemistry-4 **(30 Lectures)**

Polynuclear and heteronuclear aromatic compounds:

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene , Furan, Pyrrole, Thiophene, and Pyridine.

(6 Lectures)

Active methylene compounds:

Preparation: Claisen ester condensation. Keto-enol tautomerism.
Reactions: Synthetic uses of ethylacetoacetate

(6 Lectures)

Application of Spectroscopy to Simple Organic Molecules

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic

radiations, electronic transitions, λ_{max}, chromophore, auxochrome, bathochromic and hypsochromic shifts. Woodward rules for calculating λmax of conjugated dienes.
Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes, simple alcohols, aldehydes, ketones and carboxylic acids.

(18 Lectures)

Reference Books:

1. James E. Huheey, Ellen Keiter & Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
2. G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry*, Pearson Publication.
3. J.D. Lee: *A New Concise Inorganic Chemistry*, E.L.B.S.
4. F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley & Sons.
5. I.L. Finar: *Organic Chemistry* (Vol. I & II), E.L.B.S.
6. John R. Dyer: *Applications of Absorption Spectroscopy of Organic Compounds*,
    a. Prentice Hall.
7. R.M. Silverstein, G.C. Bassler & T.C. Morrill*: Spectroscopic Identification of*
    a. *Organic Compounds*, John Wiley & Sons.
8. R.T. Morrison & R.N. Boyd: *Organic Chemistry*, Prentice Hall.
9. Peter Sykes: *A Guide Book to Mechanism* in *Organic Chemistry*, Orient
    a. Longman.

Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand.

Course Objectives

1. To have a sound knowledge of transition metal complexes, carbonyls and organometallics, understand the role of metals in biological systems.
2. To learn about polynuclear and active methylene compounds.
3. To be able to apply and interpret the various spectroscopic techniques viz. UV-Vis and IR spectroscopy for identification of organic molecules.

Course Outcomes (Cos)

After the completion of this course, a student should be able to:

CO:1 Understand the properties of transition metals and some of their useful/ important compounds.
CO:2 Synthesis of transition metal complexes and measure their conductivity for their characterization.
CO:3 Have a sound knowledge of important organometallic compounds like carbonyls.
CO:4 Understand the roles of metals in biological systems especially in photosynthesis, enzyme catalysis, blood clotting etc.
CO:5 Understand the pros and cons of polynuclear and heterocyclic compounds.
CO:6 Apply and interpret the various spectroscopic techniques viz. UV-Vis and IR spectroscopy for identification of organic molecules.

Course Outcomes (Cos) / Program Outcomes (Pos)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1	×	×						
CO:2		×	×					×
CO:3		×						×
CO:4	×	×		×				
CO:5		×						×
CO:6		×	×					×

Note: put ‘X’in relevant column of mapping

Course Title – SEC : Pesticide Chemistry ***w.e.f. the session 2024-25 and onwards***	
Class: B.Sc. Pt.-III / Semester-V	Course code: BCH-S501
Lecture: 30	Credits: 02
MM: 70	Exam Hrs: 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

General introduction to pesticides: natural (Pyrethroids- Pyrethrins, Jasmoline, Cinerin; Rotenone, Nicotinoids, Ryania, Neem) and synthetic (Inorganic and Organic pesticides), classification, benefits and adverse effects, changing concepts of pesticides, structure activity relationship.

Synthesis and technical manufactureandusesofrepresentativepesticidesinthefollowingclasses: Organochlorines (DDT, Gammexene,); Organophosphates, phosphonates and thiophosphates (Malathion, Parathion, TEPP, Schradan, Dimefox); Carbamates (Carbofuran, Baygon and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Methods to calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.

Reference Book:

1. R. Cremlyn: *Pesticides*, John Wiley

Course Objectives

1. To learn about concept and types of pesticides, their benefits and adverse effects.
2. To be familiar with the synthesis and analysis of pesticides.

Course Outcomes (Cos)

After the completion of this course, a student should be able to:

CO:1 Understand the concept of pesticides and reasons for their need.
CO:2 Differentiate the various types of pesticides, classified on the basis of different criteria.
CO:3 Describe the environmental effects and changing concept of pesticides.
CO:4 Design the synthesis of typical and common pesticides like Baygon, Sevin, Pyrethroids etc.
CO:5 Have an elementary idea of analysis of acidity/alkalinity of pesticides formulations as per BIS specifications.

Course Outcomes (Cos) / Program Outcomes (Pos)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1	×	×		×				
CO:2		×		×				
CO:3		×		×				
CO:4		×		×				×
CO:5			×					

Note: put ‘X’in relevant column of mapping

Course Title– **SEC :** Pharmaceutical Chemistry ***w.e.f. the session 2024-25 and onwards***	
Class: B.Sc. Pt.-III / Semester-V	Course code: BCH-S501
Lecture: 30	Credits: 02
MM: 70	Exam Hrs: 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

Drugs & Pharmaceuticals

Drug discovery, design and development; Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides and Sulphamethoxazol); Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone).

Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin (iii) Lysine, Glutamic acid and Vitamin C.

Practicals

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).

Reference Books:

1. G.L. Patrick: Introduction to *Medicinal Chemistry, Oxford University* Press, UK.
2. Hakishan, V.K. Kapoor: *Medicinal and Pharmaceutical Chemistry,* Vallabh
    a. Prakashan, Pitampura, New Delhi.
3. William O. Foye, Thomas L., Lemke , David A. William: *Principles of Medicinal Chemistry*, B.I. Waverly Pvt. Ltd. New Delhi.

Course Objectives

1. To understand different types of drugs and the concept of design and development of drugs.
2. To be familiar with fermentation, synthesis and analysis of some important drugs and pharmaceuticals.

Course Outcomes (Cos)

After the completion of this course, a student should be able to:

CO:1 Understand concept of design and development of drugs.

CO:2 Explain the various common classes of Drugs like analgesic, antipyretic, antibiotic, antifungal and antilaprotic etc.

CO:3 Have an idea of synthesis of analgesic, antipyretic, antibiotic, CNS agents, antifungal and antilaprotic etc.

CO:4 Understand the fermentation, production of industrially and medicinally important ethanol, citric acid, lysine, glutamic acid and vitamin C etc.

CO:5 Have an idea of application of some common drugs like aspirin, paracetamol, ibuprofen, diazepam, chloramphenicol and dapsone etc.

CO:6 Experiment synthesis of aspirin and its analysis.

Course Outcomes (Cos) / Program Outcomes (Pos)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1		×		×				×
CO:2	×	×					×	
CO:3		×	×					×
CO:4		×						×
CO:5		×		×				
CO:6			×					×

Course Title**: DSC:**Lab Course V***, w.e.f. the session 2024-25 and onwards***	
Class B.Sc: Pt.III/ SEM V	COURSE CODE: BCH-C 551
Laboratory Periods: 60	Credits: 02
MM: 70	Exam Hrs: 04

Course Contents: Experiments

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphateand salinity of water samples by simple titration method ($AgNO_3$and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.
7. Measurement of dissolved CO_2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

Distribution of Marks:

Experiment 1: 25 Marks

Experiment 2: 25 Marks

Practical Record: 10 Marks

Viva-voce: 10 Marks

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- R.M. Felder, R.W. Rousseau: *ElementaryPrinciples of ChemicalProcesses*, Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- S. S. Dara: *A Textbook ofEngineering Chemistry*, S. Chand & Company Ltd. New Delhi.
- K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
- S. M. Khopkar, *EnvironmentalPollution Analysis*:Wiley Eastern Ltd, New Delhi.

Course Title: Chemistry-DSE: Analytical Methods In Chemistry, *w.e.f. the session 2024-25 and onwards*	
Class: Pt.-III / Semester-VI	Course code: BCH-E601
Lectures: 60	Credits: 04
M.M.: 70	Exam. Hrs.: 3:00

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Qualitative and quantitative aspects of analysis:

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if in determinate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

Basic principles of quantitative analysis*:* estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

Optical methods of analysis:

Origin of spectra ,interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.

Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choiceofsource,monochromator,detector,choiceofflameandBurner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

Thermal methods of analysis:

Theory of thermogravimetry (TG), basic principle of instrumentation.

Techniques for quantitative estimation of Ca and Mg from their mixture.

Reference Books:

- Vogel,ArthurI:ATestbookofQuantitativeInorganicAnalysis(Rev.byG.H. Jeffery and others) 5th Ed. TheEnglish Language Book Society of Longman .
- Willard,HobertH.etal.:InstrumentalMethodsofAnalysis,7th Ed.Wardsworth Publishing Company, Belmont, California, USA, 1988.
- Christian,GaryD;AnalyticalChemistry,6th Ed.JohnWiley&Sons,NewYork, 2004.
- Harris,DanielC:ExploringChemicalAnalysis,Ed.NewYork,W.H.Freeman, 2001.
- Khopkar,S.M.BasicConceptsofAnalyticalChemistry.NewAge,International Publisher, 2009.
- Skoog, D.A.Holler F.J.and Nieman, T.A. Principles ofInstrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
- Mikes,O.&Chalmes,R.A.LaboratoryHandBookofChromatographic&Allied Methods, Elles Harwood Ltd. London.

Course objects

1.To enable student to identify a problem spectroscopic technique
2.Understanding of students TGA,DTA and DSC technique
3. Understanding of students qualitative and quantitative analysis

Course Outcomes (COs)

On successful completion of the course with General Inorganic Chemistry, the student will be able to:

CO:1 Helped students in attaining basic concepts with a balanced knowledge of qualitative analysis.

CO:2 Created awareness about Optical methods of analysis for better industrial employment.

CO:3 Developed interest among students for chemistry and its application in various measurements and monitoring techniques of UV-Visible Spectrometry.

CO:4 Upgrade students' knowledge about basic concepts of Infrared Spectrometry and its applications.

CO:5 Developed and enhanced knowledge about the introduction to FlameAtomic Absorption and Emission Spectrometry and skills for its industrial employments.

CO:6 Created awareness about the role of spectroscopy.

CO:7 Created the skill in students in Thermal methods of analysis

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO:1		X			X			
CO:2				X				X
CO:3	X		X					
CO:4		X		X				
CO:5	X			X				X
CO:6	X		X				X	
CO:7			X				X	

Note: put 'X' in relevant column of the mapping

Course Title: DSE-II Lab Course: ANALYTICAL METHODS IN CHEMISTRY ***w.e.f. the session 2024-25 and onwards***	
Class: Pt.-III / Semester-VI	Course code: BCH-E651
Laboratory Periods: 60	Credits: 02
M.M.: 70	Exam. Hrs.: 3:00

Course Contents

1. Chromatography:

(a) Separation of mixtures

(i) Paper chromatographic separation of ions

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.

(b) Separate a mixture of indicators by TLC technique and identify them on the basis of their Rf values.

(c) Chromatographic separation of the amino acids by TLC

2. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

3. Determination of dissolved oxygen in water.

4. Determination of chemical oxygen demand (COD).

5. Determination of Biological oxygen demand (BOD).

Distribution of Marks:

Experiment 1: 25 Marks

Experiment 2: 25 Marks

Practical Record: 10 Marks

Viva-voce: 10 Marks

Reference Books:

 Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.

 Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

 Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

 Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.

 Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

 Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.

 Mikes, O. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.

 Ditts, R.V. Analytical Chemistry; Methods of Separation, van Nostrand, 1974.

Course title: DSE-Research Methodology for Chemistry ***w.e.f. the session 2024-25 and onwards***	
Class: **B.Sc. Pt.-III / Semester-VI**	Course code: BCH-E601
Lectures: 75	Credits: 06 (Theory-05, Tutorials-01)
MM:70	Exam Hrs:03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

Literature Survey:

Print: Sources of information: Primary, secondary, tertiary sources;
Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples.
Digital: Web resources, E-journals, Journal access, Citation index, Impact factor, H-index, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers, Search engines, Google Scholar, Chem Industry, Wiki- Databases, Science Direct, SciFinder, Scopus.

Information Technology and Library Resources: The Internet and World Wide Web. Internet resources for chemistry. Finding and citing published information.

Methods of Scientific Research and Writing Scientific Papers:
Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation.
Writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Writing ethics.Avoiding plagiarism.

Chemical Safety and Ethical Handling of Chemicals:
Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric – safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals.

Data Analysis
The Investigative Approach: Making and Recording Measurements. SI Units and their use.Scientific method and design of experiments.
Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests. Chemometrics.Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, *r* and its abuse. Basic aspects of multiple linear regression analysis.

Reference Books

- Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2011) Practical skills in chemistry. 2nd Ed. Prentice-Hall, Harlow.
- Hibbert, D. B. & Gooding, J. J. (2006) Data analysis for chemistry. Oxford University Press.
- Topping, J. (1984) Errors of observation and their treatment. Fourth Ed., Chapman Hall, London.
- Harris, D. C. Quantitative chemical analysis. 6th Ed., Freeman (2007) Chapters 3-5.
- Levie, R. de, How to use Excel in analytical chemistry and in general scientific data analysis. Cambridge Univ. Press (2001) 487 pages.
- Chemical safety matters – IUPAC – IPCS, Cambridge University Press, 1992.37
- OSU safety manual 1.01.

Course Objectives:

1. To impart the knowledge on the different ways such as print (Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, chemical abstracts etc.) and digital (Web resources, E-journals, Impact factor, H-index, Search engines, Google Scholar, Science Direct, SciFinder, Scopus) for the literature survey.
2. To explain the preparation of practical and project report, reviews, presentation and posters to help the students in the area of research.
3. To provide knowledge on plagiarism. Basic knowledge on writing research papers, writing ethics will also be delivered in the course.
4. To make aware students about the good laboratory practices such as safe storage and use of acids and hazardous chemicals , wearing apparel, first- aid and disposal of waste chemicals etc.
5. To deliver the knowledge about the analysis and presentation of data by various approaches.

Course Outcomes (COs):

CO1. Students will be able to understand how literature survey can be done by using print and digital methods discussed in the course so that they can be able to identify the problems in the different research areas.
CO2. The students will able to understand the preparation of posters, review papers, presentations and scientific research papers. and avoiding plagiarism so that they will be able to understand the seriousness of the research and contribute to the good research works.
CO3. Students will be able to understand importance of plagiarism and possible ways to avoid it.
CO4. Good laboratory practices, such as wearing apparel, emergency procedure and first aid awaraness about the storage of hazardous chemicals and reuse of laboratory chemicals can be developed in the students.
CO5. Students can be able to do the analysis of data by means of Statistical methods, Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse and Basic aspects of multiple linear regression analysis.
CO6. Students opting for higher studies will be beneficial at end of course, regarding their project/dissertation/thesis works

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO1					X		X	
CO2					X		X	
CO3					X			
CO4				X			X	
CO5	X				X			
CO6								X

Note: put ‘X’ in relevant column of mapping

Course Title: SEC-Fuel chemistry ***w.e.f. the session 2024-25 and onwards***	
Class: B.Sc. Pt.-III / Semester-VI	Course code:BCH-S-601
Lectures: 30	Credits: 04
MM:70	Exam Hrs:03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Note: Review part is for refreshing the student about the basic concept, No question should be asked from this portion.

Course Contents:

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

*Coal:*Usesofcoal(fuelandnonfuel)invariousindustries,itscomposition,carbonization of coal.Coal gas, producer gas and water gas—composition and uses. Fractionation of coaltar,usesofcoaltarbaseschemicals,requisitesofagoodmetallurgicalcoke,Coal gasification(HydrogasificationandCatalyticgasification),CoalliquefactionandSolvent Refining.

PetroleumandPetrochemicalIndustry: Composition of crude petroleum, Refining and differenttypes of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), ReformingPetroleumandnon-petroleumfuels(LPG,CNG,LNG,bio-gas,fuelsderived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene (only structure and use).

*Lubricants:*Classificationoflubricants,lubricatingoils(conductingandnon-conducting) Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Reference Books:

- E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
- P.C. Jain, M. Jain: Engineering Chemistry, DhanpatRai& Sons, Delhi.
- B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.

Course Objectives:

1. To deliver the knowledge on the classification of fuels from fossil, natural and synthetic origin and their uses.
2. To deliver knowledge about the carbonization process, formation of coke/charcoal.
3. To provide knowledge about Petroleum and Petrochemical Industry
4. To provide knowledge about fuel from waste, synthetic fuels and clean fuels.
5. To impart the knowledge on the lubricants and their type.

Course Outcomes (COs):

CO1. Students would be able to understand the different types of fuels obtained from renewable, non-renewable and synthetic sources.

CO2. Classify the various types of fuels like liquid, solid and gaseous fuels available.

CO3. After gaining the knowledge about the fuels, the students will be able to aware the society about the importance of fuels in their lives and prompt them to limit the uses of fuel.

CO4. Importance of fuels from the renewable sources and more utilization of them will be a better way to save the non-renewable fuel sources and this was clearly understood by the students after the study of the course.

CO5. Knowledge on various types of fuels such as coal, petroleum and non-petroleum could be gained by the students and also the knowledge about the petrochemicals and their uses was also enhanced after studying the course.

CO6. Knowledge on lubricants and their applications and properties was also imparted between the students.

CO7. The various properties of lubricants such as pore point, viscosity index etc. and their determination can be understood by the students after the completion of the course.

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO1	X			X				
CO2	X				X			X
CO3				X				
CO4		X		X	X			
CO5	X			X				X
CO6	X	X						X
CO7	X	X						X

Note: put ‘X’in relevant column of the mapping

Course Title: SEC-Chemistry of Cosmetics and Perfumes ***w.e.f. the session 2024-25 and onwards***	
Class: B.Sc. Pt.-III / Semester-VI	Course code:BCH-S-601
Lectures: 30	Credits: 04
MM:70	Exam Hrs:03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Practicals

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

Reference Books:

1. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.

2. P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.

3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut

(1996).

Course Objectives:

1. Knowledge about the preparation and uses of hair dyes and sprays, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours can be developed.

2. To give an explanation on the importance of various essential oils and their importance in the cosmetic sector.

3. Student will have knowledge of these cosmetic and perfume industry.

Course Outcomes (COs):

CO1. Students, when approaching the cosmetic sector will have some knowledge on the preparation of various cosmetic product discussed in the course along with their uses.

CO2. The students will also able to gain the knowledge about the role and importance of the essential oils (Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.)

CO3. Students will have knowledge of cosmetic and perfume industry

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO1	X							X
CO2	X				X			X
CO3								X

Course Title: DSC: General Inorganic Chemistry, ***w.e.f. the session 2025-26 and onwards***	
Class: Pt.-IV / Semester-VII	Course code:BCH-C701
Lectures: 60	Credits: 04
M.M.: 70	Exam. Hrs.: 3:00

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Couse contents

COORDINATION CHEMISTRY: Distortion in Complexes**,** Molecular orbital theory (M.O.T.) as applied to octahedral complexes, π - bonding in octahedral complexes, inert and labile complexes based on various theories, ligand substitution reaction in octahedral and square planar complexes, electron transfer reaction in coordination compounds. **(15 Lectures)**

ELECTRONIC SPECTRA OF COMPLEXES:Term symbols S,P,D,F, in a cubic field; splitting of term for d configuration; spectra of Transition metal complexes, selection rules and intensities of the transitions, nature of Electronic transitions in complexes, orgel energy level diagram, tanabe-sugano diagram. Calculation of Dq, B' and β for Cr III and Ni II complexes. Structural Evidence from Electronic spectra, charge-transfer spectra.**(15 Lectures)**

MAGNETOCHEMISTRY: Contribution of magnetic properties, Effect of the ligand field on spin-orbit coupling, measurement of magnetic properties, methods of magnetic susceptibility determination, temperature dependence of magnetism, application of magnetic data (Ref. book: Drago)

MOLECULAR SYMMETRY: Symmetry elements, Symmetry operations and point groups, Character Tables(C_{2V}) and applications.**(10 Lectures)**

BIOINORGANIC CHEMISTRY:General introduction to Bio-inorganic Chemistry; occurrence of Inorganic elements in organisms, classification of metallo bio-molecules; Biologically important features and functions of inorganic elements, Biologically important ligands for metal ions, co-ordination by proteins and Enzymatic catalysis.

Role of metal ions and non-metals in Biological systems Na, K, Ca, Mg, Zn, Cl, Si, As, F, I,Se (Giving suitable examples) Biomineralisation.**(10 Lectures)**

OXYGEN CARRIERS: Hemoglobin; non-porphyrin and porphyrin oxygen carriers, synthetic oxygen carriers. Recent trends in

Nitrogen fixation, photosynthesis PS- 1 & PS - 11, superoxide Dismutase.**(10 Lectures)**

Suggested Readings:

1. Inorganic Chemistry by: James E. Huheey
2. Text Book of Inorganic chemistry by: Cotton and Wilkinson 5th Edition
3. Physical Methods in Inoganic Chemistry by: R.S.Drago
4. Selected Topics in Inorganic Chemistry by: Malik, Tuli& Madan
5. Bioinorganic and Supramolecular Chemistry by: A.K.Bhagi, G.R.Chatwal

Course Objectives

In this course, students should be able to:

1. To understand the Coordination chemistry and various electronic spectra of complexes
2. To studies in detail about the Knowledge of Magneto chemistry.
3. To understand the aspects of the Molecular symmetry.
4. To studies on Basic concepts of Bio-inorganic chemistry and Oxygen Carriers

Course Outcomes (COs)

On successful completion of the course with industrial chemicals and environment, the student will be able to:

CO:1 Helped students in attaining basic concepts with a balanced knowledge of coordination Chemistry.

CO:2 Created awareness about electronic spectra of coordination compound for better industrial employment.

CO:3 Developed interest among students for chemistry and its application in various measurements and monitoring techniques of Magneto chemistry.

CO:4 Upgrade students' knowledge about basic concepts of molecular symmetry and its applications.

CO:5 Developed and enhanced knowledge about the introduction to Bio-inorganic Chemistry and skills for its Enzymatic catalysis system in human life.

CO:6 Created awareness about the role of metal ions and non-metals in Biological systems.

CO:7 Created the skill in students in Haemoglobin; non-porphyrin and porphyrin oxygen carriers, synthetic oxygen carriers.

CO:8 Created chemical knowledge in Vedic chemistry with nitrogen fixation and photosynthesis

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO:1		X			X			X
CO:2				X				X
CO:3	X		X					
CO:4				X				X
CO:5	X			X				X
CO:6	X		X		X			
CO:7			X				X	
CO:8						X		

Note: put 'X'in relevant column of the mapping

Course Title **:**DSC-GENERAL ORGANIC CHEMISTRY, ***w.e.f. the session 2025-26 and onwards***	
Class B.Sc : PT.IV / SEM VII	COURSE CODE : BCH-C 702
Lecture:60	Credits: 04
MM: 70	Exam Hr : 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

Organic Reaction Mechanism:

(a) Substitution or Displacement Reactions: Nucleophilic and electrophilic substitutions with mechansim (S_N and S_E), Frie's rearrangement, Friedeal-Craft reactions, Reimer-Tiemann reaction, Chichibabin reaction.

(b) Addition Reactions: Electrophilic and nucleophilic additions with mechanism, hydroboration, Michael addition, sharpless asymmetric epoxidation; aldol, Perkin, Stobbe condensations, Cannizaro reaction, Wittig reaction. (10 Lectures)

Reaction Intermediates: Carbocations, carbanions, free radicals, nitrines and benzyne, their formation, stability, detection and reactions.

Molecular rearrangements: Involving electron deficient carbon, nitrogen and oxygen viz- Pinacol-pinacolone, Wagner-Meerwein, Beckmann, Hofman, Lossen, Curtius, Schmidt rearrangements, Bayer-Villiger oxidation of ketones. Favorskii, Demjanov rearrangements. (10 Lectures)

Reagents in organic synthesis: Useof the following reagents in organic synthesis: Gilman's reagents, lithium diisopropyl amide (LDA), 1,3-dithiane, osmium tetroxide, selenium dioxide.

Heterocyclic Compounds: Aromaticity, synthetic methods and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. (10 Lectures)

Pericyclic reactions: Classification of Pericyclic reactions**,** Selection rules and stereochemistry of electrocyclic reactions, cycloaddition and sigmatropic shifts. Sommelet-Hauser, Cope and Claisen rearrangements, ene reaction.

Photochemical reactions: Cis-trans isomerization, Paterno-Buchi reaction, Norrish type I and II reactions of α, β unsaturated ketones, photo reduction of ketones, di-pimethane rearrangement, photochemistry of arenes. (10 Lectures)

Stereoisomerism: Optical activity and Optical isomerism, Racemic mixture, Resolution, R-S nomenclature. Geometrical isomerism in the compounds containing C = C and C = N bonds, elementary idea of geometrical isomerism in cyclic compounds. E-Z nomenclature.

Stereochemistry: Asymmetric induction, prochiral relationships, stereoselective and stereospecific reactions and their use in reaction mechanism, Stereochemistry of substituted cycloalkanes. (10 Lectures)

Suggested Readings:

1. Organic Chemistry by: Boyd and Morrison
2. Organic Chemistry by: I.L.Finar
3. Organic Chemistry by: Kapoor, Singh and Mukherjee
4. Organic Chemistry by: Bruice
5. Organic Chemistry by: Pine
6. A Guide Book to Organic Reaction Mechanism by: Peter Sykes

Course Objectives

1. To understand the basics of organic reaction mechanism.
2. To learn about photochemical and pericyclic reactions and various reagents for synthesis.
3. To understand the concept and application of stereochemistry.

Course Outcomes (Cos)

After the completion of this course, a student should be able to:

CO:1 Understand the basics of organic reaction mechanism.

CO:2 Apply the organic name reactions important in chemical industries like aldol reaction, Michael addition, hydroboration etc.

CO:3 Understand the reaction intermediate and all types of molecular rearrangement.

CO:4 Have a basic understanding of use of reagent in organic synthesis like LDA, Gillman reagent etc.

CO:5 Understand the mechanism and application of pericyclic and photochemical reactions.

CO:6 Have understanding of industrial synthesis of representative heterocyclic compounds applicable in various fields of pharmaceutical drugs.

CO:7 Understand the stereochemical aspect of organic molecules asymmetric induction and stereospecific reactions.

Course Outcomes (Cos) / Program Outcomes (Pos)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1	×	×						
CO:2		×						×
CO:3		×						
CO:4	×	×						×
CO:5	×	×						
CO:6		×		×				×
CO:7		×						

Note: put ‘X’in relevant column of the mapping

Course Title **: DSC:** GENERAL PHYSICAL CHEMISTRY***, w.e.f. the session 2025-26 and onwards***	
Class B.Sc : PT.IV / SEM VII	COURSE CODE : BCH-C 703
Lecture: 60	Credits: 04
MM: 70	Exam Hr : 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Chemical Kinetics - I: Derivation of IIIrd order kinetic equation, collision theory for uni, bi and termolecular reactions, Steric factor, Theory of absolute reaction rates, Entropy of activation. Experimental techniques for the study of kinetics of slow and fast reactions. Potential energy surfaces (two-dimentional and 3-dimentional diagrams), P.E. surface for $H + H_2$ reaction, Concept of COL and Contour diagram.
(10 Lectures)

Chemical Kinetics - II: Opposing, Consecutive, Side and Induced reactions, Induction period. Chain reactions and explosion limits. Reactions in solution, Factors affecting the rates in solutions, effect of solvation and Internal pressures, Double and Single sphere models, Effect of ionic strength, Bronsted-Bjerrum equation, Numerical Problems. (10 Lectures)

Linear Free energy Relationships: Effect of substituents on reaction rates, Basic idea of linear free energy relationships particularly Hammett, Taft, Brown and Okamoto, Sekigawa and Van - Bakkum plots (Introductory treatment only). (10 Lectures)

Catalysis: Acid- Base catalysis, Acidity function, Enzyme -catalysis, Michaelis-Menten equation.
Photochemistry: Jabolinskii diagram, fluorescence, phosphorescence, chemiluminiscence and photosensitization, photophysical kinetics of unimolecular process. (10 Lectures)

Macromolecules : Explaining the terms Isotactic, Atactic, Syndiotactic, Copolymers, Block copolymers, Linear, Branched and Cross linked polymers, Addition and condensation polymerisation. Degree of polymerisation and length of polymer chains. Requirement of purity for synthesis. Molecular weights and their distribution. Polydispersity. Determination of molecular weight by Osmotic pressure, Viscosity, light scattering and sedimentation equilibrium methods. (10 Lectures)

Suggested Readings :

1. Chemical Kinetics by: K.J. Laidler
2. Enzyme Kinetics by: D.V. Roberts
3. Text book of Physical Chemistry by: S. Glasstone
4. Chemical Kinetics by: Ralphe Jr. Westron and A.S. Harold
5. Physical Chemistry by: G.M. Barrow
6. Physical Chemistry by: G.W. Castellan
7. Introductory Polymer Chemistry by: G.S. Misra
8. Physical Organic Chemistry by: N.S. Issacs

Course objective

1. To enable student to identify a problem chemical kinetics reaction and experimental technique and potential energy diagram
2.Understanding of students photochemical reactions problem
3. Understanding of students Effect of substituents on reaction rates

4.To learn student preparation of macromolecule

Course out comes (Cos)

CO:1 Helped students in attaining basic concepts with a balanced knowledge of chemical kinetics.

CO:2 Created awareness about kinetic study of different types of chemical reaction and developed the mechanism for better industrial employment.

CO:3 Developed interest among students for physical chemistry and its application in various measurements and monitoring techniques of catalyst.

CO:4 Upgrade students' knowledge about basic concepts of effect of substituents on reaction rates and its applications in organic laboratories.

CO:5 Developed and enhanced knowledge about the introduction to photo chemistry and skills for its fluorescence, phosphorescence, chemiluminiscence and photosensitization system.

CO:6 Created awareness about the macromolecules.

CO:7 Created the skill in students in macromolecules or polymer chemistry.

CO:8 Created chemical knowledge in Vedic chemistry with catalysis process

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO:1	X				X			X
CO:2				X				X
CO:3	X		X					
CO:4		X		X			X	
CO:5				X				X
CO:6	X				X			
CO:7		X	X				X	
CO:8						X		

Note: put 'X'in relevant column of the mapping

Course Title **: DSC:** LAB COURSE ***w.e.f. the session 2025-26 and onwards***	
Class B.Sc : PT.IV / SEM VII	COURSE CODE : BCH-C 751
Laboratory periods:120	Credits: 06
MM: 70	Exam Hr : 03

Course Contents: Experiments

A. Inorganic Chemistry:

(a) Analysis of inorganic mixture for 04 ions including 02 cations. Special emphasis may be given on dry tests and spot tests (including rare earths).

(b) Preparation of the following complexes and determination of their composition by volumetric and Gravimetric techniques ;

(i) Nickle complexes with ethylene diammine and mono or diketones.

(ii) Cobalt Pentammine Chloride. [Co(NH3)5 Cl]Cl2

B. Organic Chemistry:

(i) Separation of organic mixture and identification, confirmation by derivative preparation as far as possible.

(ii)Estimation of Amino group in Aniline (Volumetrically).Estimation of Carboxylic group and Glucose.

C. Physical Chemistry: Experiments related to following techniques Experiments related to following techniques :

(1) Phase rule (2) Distribution Law

(3) Chemical Kinetics (4) Thermochemistry

Distribution of Marks:

Experiment 1: 25 Marks

Experiment 2: 25 Marks

Practical Record: 10 Marks

Viva-voce: 10 Marks

Course Title: Chemistry -DSE: Major Project ***w.e.f. the session 2025-26 and onwards***	
Class: B.Sc. Pt.-IV / Sem-VII	Course code: BCH-E771
Lectures:72(Equivalent)	Credits:06
MM : 70	Exam.Hrs.: 03

NOTE: The student shall present the work before a panel of two examiners consisting of the supervisor concerned and an expert/examiner appointed by the University.

Course Contents:

STEP-1

The student will undertake project work on identified topic at Department of Chemistry, Gurukul Kangri University main campus and Kanya Gurukul Campus (For Girls Only), under the supervision of a teaching staff member.

STEP-2

Study of Methodology of Experiments

STEP-3

Experimental design

STEP-4

Presentation of data in different way.

STEP-5

Writing a project report with conclusion and submit the same for evaluation.

References

Depending on the type of problem, literature can be arranged/searched under supervisor.

Course Objectives

1.To enable student to identify a problem in the field of chemistry
2.To carry out literature survey for identified problem
3.Designanexperiment for the identified problem on the basis of literature.
4. To perform experimental work related to the problem in Lab.
5.To analyze data obtained from above experiments and write a report

Course Outcomes (COs)

By the end of this course, students will be able to:
CO:1 Student will learn How to work on identified topic systematically
CO:2 Do study of Methodology of Experiments
CO:3 Use of laboratory resources judiciously to complete above set of experiments.
CO:4 Presentation of data in different way.
CO:5 Writing a project report with conclusion and submit the same for evaluation to supervisor.
CO:6 Work in a team under the supervision of a teacher.
CO:7 Develop scientific writing skills.

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
CO:1	X						X	
CO:2	X	X		X				X
CO:3			X	X				X
CO:4	X				X		X	
CO:5			X		X		X	
CO:6								X
CO:7		X			X			

Put ‘X’ in relevant column of mapping

Course Title: DSC-Chemistry and Related Techniques of Analysis ***w.e.f. the session 2025-26 and onwards***	
Class: PT.IV / SEM VIII	Course code: BCH-C801
Lectures: 60	Credits: 04
MM: 70	Exam Hrs: 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Interaction of radiation with matter:
Units of Radioactivity(Ci, Ru, Bq, Specific activity), units of radiation energy(rad, Gray,Röntgen, RDE, REM, Sievert),Measurements of activity, Geiger Muller counter, Proportional and scintillation counters, Application of Radioactive tracers, Isotopic dilution (IDA)and activation analysis(NAA). (10 Lectures)

Raman Spectroscopy :
Base Concepts of Raman Spectroscopy, Principle, instrumentation and applications. Fundamentals of ESR spectrum, E.S.R. spectra of transition metal complexes, spin Hamiltonian, Instrumentation and application of E.S.R. spectroscopy. (10 Lectures)
Principle, instrumentation and applications of Atomic absorption spectroscopy and atomic emission spectroscopy, flame photometric methods of estimation of alkali and alkaline metals, Nephelometry and Turbidimetry. **(10 Lectures)**
Thermal Analytical methods :
Scope, classification, Principles, instrumentation and applications of Thermo gravimetric analysis, Differential thermal analysis and differential scanning calorimetry. Thermometric titrations. (10 Lectures)

Inductively Coupled Plasma:
Principle, Technique, Instrumentation and Applications. Analysis of mineralogical samples, Analysis of water, Applications in biological systems. (10 Lectures)

Suggested Readings:

1. Instrumental Methods of Chemical Analysis by: G.W.Ewing, Mc Graw Hill Book Company
2. A Text book of Quantitative Inorganic Analysis by: A.I.Vogel
3. Inorganic Thermogravimetric Analysis by: Duval
4. Modern Methods of Chemical Analysis by: R.L.Pecsok and L.D.Shields
5. Thermal Analysis by: Antonin Blazek

Course Objectives
1. Interaction of radiation with matter
2. Raman Spectroscopy
3. Atomic absorption spectroscopy, Atomic emission spectroscopy, Nephelometry and Turbidimetry
4. Thermal Analytical methods
5. Inductively Coupled Plasma technique

Course Outcomes (COs)
CO:1 To understand the concept of Interaction of radiation with matter
CO:2 Theories of Raman & ESR Spectroscopy
CO: 3 Various concept and difference betweenAtomic absorption spectroscopy, Atomic emission spectroscopy
CO:4 Role of Nephelometry and Turbidimetry
CO:5 Studies various application of thermal analytical methods

CO:6 Principle, theories and application of Inductively Coupled Plasma

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO:1	X	X			X		X	X
CO:2			X	X				X
CO:3		X	X				X	X
CO:4		X	X				X	
CO:5			X				X	X
CO:6		X	X				X	X

Note: put ‘X’in relevant column of mapping

Course Title– **DSC:** Organic Chemistry and Related Techniques of Analysis**,** ***w.e.f. the session 2025-26 and onwards***	
Class: B.Sc. Pt.-IV / Semester-VIII	Course code: BCH-C802
Lecture: 60	Credits: 04
MM : 70	Exam.Hrs.: 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

UV-Vis Spectroscopy: Electromagnetic spectrum, electronic band spectra (UV and Vis region), laws of absorption (Beer's-Lambert law), molar extinction coefficient. Types of electronic transitions, Elementary idea of chromophores, auxochromes, bathochromic and hypsochromic shifts, hyperchromic and hypochromic effects, Instrumentations and technique of UV-VIS Spectroscopy, Woodward-Fieser rules, solvent effects on π-π^* and n- π^* transitions, Applications of UV-VIS spectroscopy. Problems pertaining to the structure elucidation of organic compounds using UV spectroscopic techniques. (Lectures: 10)

IR spectroscopy: Vibrational rotational spectra- Principle, absorption of infrared radiation & molecular vibration-rotations. Fundamental vibration, overtones and combination tones. finger print region, infrared vibration - active and forbidden (selection rules). Instrumentation, factors affecting vibrational frequencies, spectral study of different functional groups. Idea of rotational spectrum. Problems pertaining to the structure elucidation of organic compounds using IR spectroscopic techniques. (Lectures: 10)

NMR spectroscopy: H^1-NMR;Basic concept,instrumentation, FTNMR, chemical shift, shielding & deshielding, homotopic and diasteriotopic protons, spin-spin coupling, coupling constant, AX and AX_2 type spectra, spin decoupling, lanthanide shift reagents. C^{13}-NMR spectroscopy. Problems pertaining to the structure elucidation of organic compounds using NMR spectroscopic techniques. (Lectures: 10)

Mass spectrometry: Basic principle, fragmentation pattern of major functional groups, instrumentation, Mclafferty rearrangement, metastable ions, retro Diels-Alder reaction, general applications. Problems pertaining to the structure elucidation of organic compounds using Mass spectroscopic techniques. (Lectures: 10)

Suggested Readings:

1. Spectroscopy by: C. J. Benwell
2. Spectroscopic Identification of Organic Compounds by: Silverstein, Bassler, Morrill
3. Organic Chemistry by: Kapoor, Singh , and Mukherjee
4. Organic Chemistry by: Boyd and Morrison
5. Organic Spectroscopy by: W. Kemp
6. Organic Spectroscopy by: Jagmohan

Course Objectives

1. To learn the basic principle and characteristics of UV-Vis, IR, H^1-NMR and C^{13}-NMR techniques.
2. To apply the above techniques for structure elucidation of unknown compounds.

Course Outcomes (Cos)

After the completion of this course, a student should be able to:

CO 1. Learn the technique of UV-Visible spectroscopy.

CO:2 Understand the basics of IR spectroscopy, factors affecting the vibrational frequencies.

CO 3. Explain the basic principle of NMR spectroscopy, deshielding, anisotropic effect, off-resonance etc.

CO 4. Examine the UV-Vis, IR, H^1-NMR and C^{13}-NMR spectra of unknown compounds.

CO 5. Understand the basic principle and applications of Mass spectrometry, Fragmantation pattern of different class of compounds.

Course Outcomes (Cos) / Program Outcomes (Pos)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1	×	×					×	
CO:2		×		×				×
CO:3		×	×					
CO:4		×	×					
CO:5	×	×			×			

Course Title**: DSC**: Physical Chemistry and Related Techniques of Analysis, ***w.e.f. the session 2025-26 and onwards***	
Class: B.Sc. Pt.-IV / Semester-VIII	Course code: BCH-C803
Lectures :60	Credits: 04
MM: 70	Exam Hrs.:03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Treatment of Data in Quantitative Analysis: Accuracy, Precision, Methods for expressing the accuracy and precision, Standard deviation, Types of errors, Elimination and minimization of errors, Significant figures, Criterion for the rejection of data. (Lectures: 10)

Signal, Noise, Sensitivity Detection Limits, FT: Elementary idea of signal to noise ratio, Sensitivity and detection limits, Types and sources of noise (Thermal, shot, Flicker and Environmental noise). Eliminations/Minimization of noise, Time domain & frequency domain plots in emission spectroscopy. Basic idea and applications of Fourier transformation. (Lectures: 10)

Polarisation and Overvoltage: Theories of Hydrogen overvoltage, Ilkovic equation, d.m.e., Half wave potential, Diffusion current, Polarography and its simple and general applications. (Specific applications not required)

Ion Exchange: Cation and Anion exchangers, their Stability, Selectivity and Characteristics, General applications including Ion Exchange Chromatography. (Lectures: 10)

Conductometric, Potentiometric and pH–metric Titrations: Theory, Technique and applications of Conductometric, Potentiometric and pH- metric titrations.

Solvent Extraction: Principles, Techniques and applications. (Lectures: 10)

Chromatographic Techniques: Basic principles, Experimental techniques, Simple and general applications of Column, Paper, Thin layer, Gas-solid, Gas- liquid and High-Performance Liquid Chromatography (excluding specific applications). (Lectures: 10)

Suggested Readings:

1. Instrumental Methods of Analysis by: Willard Merit, Dean and Seatle
2. Instrumental Methods of Chemical Analysis by: G. W. Ewing
3. Text book Physical Chemistry by: S. Glasstone
4. Hand Book of Chromatography for Chemists and Engineers by: M. K. Shingari
5. Analytical Chemistry by: I. M. Kolthoff
6. Quantitative Analysis by: Vogel
7. Qualitative Analysis by: Vogel
8. Mathematics and Statistics for Chemists by: C. J. Brooks, I. G. Betteley and S. M. Lexsten
9. Molecular Spectroscopy by: C. J. Benwell

Course Objectives

1. To Treatment of Data in Quantitative Analysis, Signal, Noise, Sensitivity Detection Limits, FT
2. Studies on Polarization, Overvoltage, Basic Polarography and Ion Exchange
3. Knowledge of Conductometric, Potentiometric and pH–metric Titrations and Solvent Extraction
4. To develop skill in chromatographic Techniques

Course Outcomes (COs)

On successful completion of the course with Physical Chemistry and Related Techniques of Analysis, the student will be able to:

CO:1 Helped students in attaining basic concepts with a balanced knowledge of treatment of Data in Quantitative Analysis.

CO:2 Created awareness about Signal, Noise, Sensitivity Detection Limits for better industrial employment.

CO:3 Developed interest among students for chemistry and its application in various measurements and monitoring techniques of Fourier transformation infra-red spectroscopy and handling of instruments.

CO:4 Upgrade students' knowledge about basic concepts of polarization and over voltage. Educated in various measurements and monitoring techniques of industrial waste management for better industrial employment.

CO:5 Developed and enhanced knowledge about the ion exchange and skills for its Management of chromatography.

CO:6 Created awareness about the Conductometric, Potentiometric and pH–metric Titrations.

CO:7 Created the skill in students for better employment in chromatography R & D laboratories.

CO:8 Created chemical knowledge in Vedic chemistry with analysis of data.

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	1	2	3	4	5	6	7	8
CO:1		X						X
CO:2	X			X				X
CO:3	X		X					
CO:4				X				X
CO:5		X		X			X	
CO:6			X	X	X			
CO:7			X				X	X
CO:8						X		

Note: put 'X'in relevant column of mapping

Course Title : DSC: LAB COURSE-VIII ***w.e.f. the session 2025-26 and onwards***	
Class B.Sc : PT.IV / SEM VIII	COURSE CODE : BCH-C 851
Laboratory periods:120	Credits: 06
MM: 70	Exam Hr : 03

Course Contents: Experiments

1.General Chemistry behind Experiments: Basic Idea of Calibration Curves, Angle of rotation, Refractive Index, Refractometry, Polarimetry, Turbidimetry/ Nephelometry

2.General Chemistry behind Experiments: Spectrophotometry, Absorbance, Bear-Lambert Law, Absorption Maxima, Flamephotometry.

3. Hands On Experiments

Experiments related to pH metry, Conductometry, Paper chromatography and Thin layer chromatography.

Distribution of Marks:

Experiment 1: 25 Marks

Experiment 2: 25 Marks

Practical Record: 10 Marks

Viva-voce: 10 Marks

Course Title: Chemistry -**SEC**: CHEMISTRY IN VEDIC LITERATURE AND AYURVEDIC DRUGS ***w.e.f. the session 2025-26 and onwards***	
Class: B.Sc. Pt.-IV/ Semester-VIII	Course code: BCH-S801
Lectures:30	Credits:02
MM : 70	Exam.Hrs.: 03

NOTE: The question paper shall consist of Two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer (about 150 words) type questions of SIX marks each and student shall be required to attempt any five questions. Sec.-B shall contain 08 descriptive type questions of TEN marks each and student shall be required to attempt any four questions. Both sections shall have questions from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course Contents:

(a)Chemistry in vedic literature and Indian philosophy: (Lectures: 06)

Kanad's atomic theory, Concept of Parmanu, Formation of molecules, Parimandal, Comparison with Dalton's atomic theory and models of Thomson, Rutherford and Bohr. First and Second law of thermodynamics in daily life. Entropy in life and concept of Pralaya. Dhananjay Vs Concept of Radioactivity – Life after death. Atomic Spectrum Vs Concept of Kundalini.

(b) **Pharmacodynamics of Ayurvedic drugs**: Brief description of Rasa, Guna, Vipaka, Virya, and Prabhava.

(c) **Classification and Constituents of Crude Drugs**: Brief and introductory idea of drug constituents and their Chemical and Pharmacological classification. (Lectures: 06)

(d) **Plant Analysis**: Methods of extraction, Isolation separation and identification of various constituents (Introductory description). Isolation of Caffine from Tea leaves, Isolation of Piperine from black piper and Isolation of curcumine from turmeric. (Lectures: 06)

(e) **Analysis of Ayurvedic Drugs**: General idea of analysis of active constituents and standarization of Ayurvedic drugs, (Lectures: 06)

(f) **Analysis of Modern drugs**: Assay and identification of Aspirin, Ascorbic acid and Paracetamol. (Lectures: 06)

References

1. Alchemy and Metallic Medicines in Ayurveda by: Vaidya Bhagwan Das
2. History of Hindu Chemistry by: P. C. Ray
3. Ayurvediya Rasa Shastra by: Siddhinandan Misra
4. Ayurvediya Rasa Shastra by: Dr. Chandra Bhushan Jha
5. Indian Alchemy by: Dr. S. Mahdihassan
6. Indian Pharmacopoea 2010
7. Text Book of Pharmacognosy by: Mahammed Ali
8. Rasajalnidhi Vol. I - III
9. Ancient Scientists of India by Satya Prakash
10. Phytochemical Methods by: J. B. Harborne (Chapmann & Hall)
11. Vaisheshik Darshan by Kanad

Course Objectives

1.Chemistry in Vedic literature and Indian philosophy
2.Metallic Medicines in Ayurveda
3.Pharmacodynamics of Ayurvedic drugs
4.Classification and Constituents of Crude Drugs
5.Plant Analysis
6.Analysis of Ayurvedic and Modern drugs

Course Outcomes (COs)

By the end of this course, students will be able to:

CO:1 Understand the ancient vedic chemistry and its comparison with Modern theories.
CO:2 This will provide the basics of Metallic medicines as per Ayurved.
CO:3 Understanding of Ayurvedic Pharmacodynamics Increases along with classification of crude drugs.
CO:4 Provides basics of Phytochemistry and its applications.

CO:5 Enhances the knowledge of Drug analysis.
CO:6 Course will provide knowledge of chemistry applications from ancient to modern times.

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO:1	X							
CO:2				X	X			
CO:3					X	X		
CO:4	X				X		X	
CO:5	X	X	X				X	X
CO:6	X	X	X				X	X

Put ‘X’ in relevant column of mapping

Course Title: Chemistry DSE: DISSERTATION ***w.e.f. the session 2025-26 and onwards***	
Class: B.Sc. Pt.-IV / Semester-VIII	Course code: BCH-E 801
Lectures:72(or equivalent)	Credits:06
MM : 70	Exam.Hrs.: 03

NOTE: The student shall present the work before a panel of two examiners consisting of the supervisor concerned and an expert/examiner appointed by the University.

Course Contents:

STEP-1

Identification of research Problem

STEP-2

Survey of literature

STEP-3

Experimental design and methodology,

STEP-4

Analysis of data and interpretation of results,

STEP-5

Writing a project report with Discussion and conclusion

References

Depending on the type of problem, literature can be arranged/searched under supervisor

Course Objectives

1.To enable student to identify a problem in the field of chemistry
2.To carry out literature survey for identified problem
3.Design an experiment for the identified problem on the basis of literature.
4.To perform experimental work related to the problem in Lab.
5.To analyze data obtained from above experiments and write a report.

Course Outcomes (COs)

By the end of this course, students will be able to:
CO:1 Student will learn How to search a research problem
CO:2 Do study and cite published literature on a particular area of interest.
CO:3 Correlate the experimental observations with available literature.
CO:4 Use of laboratory resources judiciously for particular problem.
CO:5 Interpret results, write a report and submit to the supervisor.
CO:6 Work in a team under the supervision of a teacher.
CO:7 Develop scientific writing skills.

Mapping of course Outcomes (COs) with program outcomes (POs)

Course Outcomes/Program outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CO:1	X						X
CO:2	X	X		X			
CO:3			X	X			
CO:4	X				X		X
CO:5			X		X		X
CO:6						X	X
CO:7		X			X		

Put ‘X’ in relevant column of mapping