ORDINANCES, TEST OUTLINES, SYLLABI and READING COURSES

For

B.Sc. (Honours) Multidisciplinary PART I
(SEMESTER I & II)

Academic Sessions
2025–26, 2026-27

Under
Choice-Based Credit System (CBCS)
Scheme of

NEP 2020

PROGRAMME CODE: BCHE

DEPARTMENT OF CHEMISTRY
GURU NANAK COLLEGE
BUDHALADA
(An Autonomous College)
NAAC Accredited 'A++' Grade
College with Potential for Excellence Status by
UGC, Star College Status-DBT
E-mail: gncbudhlada@yahoo.co.in
Website: www.https://www.gncbudhlada.org
Under Punjabi University, Patiala

B.Sc. (HONOURS) MULTIDISCIPLINARY Part-I
(SEMESTER I & II)
SESSIONS 2025-26, 2026-27

Semester-I							
Paper Code	**Title of Paper**	**Credits**	**Hours (Per Week)**	**Max Marks**	**External Exam**	**Internal Assessment**	**Examination Time (hrs.)**
BCHE1101T	**MAJ**: Chemistry-I	03	03	100	70	30	03 hrs.
BCHE1102P	**MAJ-LAB**: Chemistry Practical-I	01	02	50	35	15	03 hrs.
BCHE1103T	**MIN**: Chemistry-I	03	03	100	70	30	03 hrs.
BCHE1104P	**MIN- LAB**: Chemistry Practical-I	01	02	50	35	15	03 hrs.
BCHE1105T	**IDC/MDC**: Chemistry in Daily Life	03	03	100	70	30	03 hrs.
BCHE1106T	**SEC**: Chemistry of Cosmetics and Perfumes	03	03	100	70	30	03 hrs.
Semester-II							
BCHE1201T	**MAJ**: Chemistry-II	03	03	100	70	30	03 hrs.
BCHE1202P	**MAJ-LAB**: Chemistry Practical-II	01	02	50	35	15	03 hrs.
BCHE1203T	**MIN**: Chemistry-II	03	03	100	70	30	03 hrs.
BCHE1204P	**MIN-LAB**: Chemistry Practical-II	01	02	50	35	15	03 hrs.
BCHE1205T	**IDC/MDC:** Basic Analytical Chemistry:	03	03	100	70	30	03 hrs.
BCHE1206T	**SEC**: Chemistry of Drugs	03	03	100	70	30	03 hrs.

1. MAJ: Discipline Specific Core Course; **MAJ-LAB**: Discipline Specific Core Practical Course; **MIN**: Minor Core Courses; **IDC/MDC:** Inter Disciplinary Courses; **AEC**: Ability Enhancement Course; **VAC**: Value Added Course; **SEC**: Skill Enhancement Course

Note:

2. *The credit of the minor will be 04 (03 credit for theory and 01 credit for Practical). The contact hours of the minor will be 05 hours (03 hours Theory and 02 hours Practical).

3. Weightage of different components in internal assessment of theory papers is as: Attendance-20%, Assignment/Project/Seminar/Lab Work-40% and Internal Examination (Mid Semester Written Exam)-40%.

BCHE1101T: CHEMISTRY MAJOR-I

Maximum marks: 100 marks
End Semester Exam: 70 marks
Internal Assessment: 30 marks
Pass Percentage: 35%

Credits: 03
Time allowed: 3hrs
Total lectures: 60 hrs

COURSE OBJECTIVES:

1. To study wavefunctions and probablility distribution curve.
2. To emphasize on atomic structure, bonding and periodicity of elements.
3. To understand the reactive intermediate involved in organic reactions.
4. To understand chemical Kinetics of various reactions.

COURSE OUTCOMES:

1. Define and explain the behaviour and interactions between matter and energy at the atomic level. Quantum mechanics explain the many observed phenomenon like SWE, quantum mechanics etc.
2. Variation of periodic properties like Atomic and ionic radii, ionization energy, electronic affinity and electronegativity.
3. Illustrate the fundamental concepts of organic chemistry and the reactive intermediates involves through the reaction.
4. Explain the various methods of preparations and reactions of aliphatic hydrocarbons like alkanes, alkenes and alkynes which is the important part of organic synthesis
5. Illustrate the concept of rate of a reaction, factors influencing the rate of a reaction, Arrhenius equation and their numericals.

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 12 marks each. Section C will consist of 11 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting two questions each of A & B sections. Section C is compulsory.

Section – A

Atomic Structure

Idea of de-Broglie matter waves, derivation of de- Broglie equation, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, the significance of ψ and ψ^2, quantum numbers, radial and angular wave functions (excluding mathematical relations), probability distribution curves in terms of R(r) vs r and R(r) vs r^2 (for 1s, 2s 3s and 2p, 3p, 4p subshells), shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's rule of multiplicity. Electronic configurations of the elements and ions (Atomic number upto 30).

Periodic Properties

Position of elements in the periodic table, effective nuclear charge and its calculations. Atomic and ionic radii, ionization energy, electronic affinity and electronegativity-definition, methods of determination or evaluation, trends in periodic table.

Structure and Bonding
Hybridization, Bond length and bond angles, Bond Energy, Localized and Delocalized chemical bond, Van der Waal's interaction (dipole-dipole; dipole-induced dipole; induced dipole - induced dipole interactions), Resonance, Hyperconjugation, Inductive and Hydrogen Bonding.

Reaction Intermediates
Curved arrow notation, Drawing electron movements with arrows, half-headed and double headed arrows, hemolytic and heterolytic bond breaking, Types of reagents (Types, structure and stability) -Electrophiles and Nucleophiles, Reactive intermediates-Carbocations, Carbanions, Free Radicals.

Section -B

Alkanes
Structure, IUPAC Nomenclature, and Isomerism. Methods of Preparation (from alkyl halide, Wurtz reaction, Corey-House synthesis), Physical properties, Halogenation of alkanes and its mechanism -Relative reactivities of halogens, and different classes of hydrogen atoms; Reactivity, and Selectivity.

Chemical Kinetics
Chemical kinetics and its scope, Rate of a reaction, factors influencing the rate of a reaction (qualitative analysis only) - concentration, temperature, pressure, solvent, light, catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions zero order, first order, second order, pseudo order, half-life, and mean life. Determination of the order of reaction - differential method, method of integration, method of half-life period, and isolation method. Radioactive decay as a first-order phenomenon (only numericals).

Chemical Kinetics-II
Theories of Chemical Kinetics, Effect of temperature on rate of reaction, Arrhenius equation (without derivation), concept of activation energy (graphical representation for exothermic and endothermic reactions). Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant.

Books Recommended

1. *Quantum chemistry and molecular spectroscopy.* KL Kapoor
2. *Quantum chemistry: through problem solving and solutions*: RK Parsad
3. *Chemical structure and Bonding*: Roger L. dedock Hary B. Gray
4. *Atomic structure and chemical bond*: A problem solving approach: Manas Chanda
5. *Reactive Intermediate in organic chemistry*: Structure, Mechanism and Reaction Maya Shankar Singh, Wiley VCH
6. *Intermediate Organic chemistry*: second edition: John C Stowell
7. *Puri Sharma Pathania* Principles of Physical Chemistry

CHEMB 1102P: PRACTICAL CHEMISTRY -I (For Major)

Max Marks: 50 marks **Credits:01**
Semester Paper: 35 marks **Time allowed- 3 hrs**
Internal Assessment: 15 marks **02 hours/week**
Pass Marks: 35%

INSTRUCTIONS FOR THE PAPER SETTERS, EXAMINERS & CANDIDATES

The Practical Examinations will be held in the one morning/evening session that will be of 3 hours duration. During this session students will perform following two types of experiments:
(a). Semi micro analysis along with
(b). Crystallization of the given sample.
Paper setter will enlist five different mixtures and the examiner will randomly distribute these mixtures amongst the students. Each candidate will analyze one mixture along with crystallization of the given sample. Students are permitted to consult the books for the scheme of tests for semimicro analysis.

PRACTICAL EXERCISE
SEMI-MICRO ANALYSIS:
Cation analysis, separation, and identification of ions from Groups I, II, III, IV, V and VI. Anion analysis (2 cations and 2 anions with no interference).

CRYSTALLIZATIONS:
(i) Phthalic acid from hot water;
(ii) Acetanilide from boiling water;
(iii) Naphthalene from ethanol;
(iv) Benzoic acid from water.

DETAILSOFDISTRIBUTIONOFMARKS

1. Semi-Micro analysis:	15 Marks
2. Crystallization:	05 Marks
3. Viva-voce:	10 Marks
4. Practical Note Book:	05 Marks
5. Total Marks	35 Marks

Books Recommended

I. *Vogel's Qualitative Inorganic Analysis,* revised, Svehla, Orient Longman.
2. *Vogel's Textbook of Quantitative Inorganic Analysis* (revised), J. Basseff, R.C. Dennery, G.H. Jeffery and J. Mendham, ELBS.
3. *Standard Methods of Chemical Analysis,* W.w. Scott the Technical Press.
4. *Experimental Inorganic Chemistry:* W.G. Palmer, Cambridge.
5. *Modern Practical chemistry:* S. Kiran Kavya

BCHE1103T: CHEMISTRY MINOR-I

Maximum Marks: 100 marks **Credits: 03**
External Examination: 70 marks **Time allowed: 3 hrs**
Internal Assessment: 30 marks **Total lectures: 60 hrs**
Pass Percentage: 35%

COURSE OBJECTIVES:

1. To study wavefunctions and probablility distribution curve.
2. To emphasize on atomic structure, bonding and periodicity of elements.
3. To understand the reactive intermediate involved in organic reactions.
4. To understand chemical Kinetics of various reactions.

COURSE OUTCOMES:

1. Define and explain the behaviour and interactions between matter and energy at the atomic level. Quantum mechanics explain the many observed phenomenon like SWE, quantum mechanics etc.
2. Variation of periodic properties like Atomic and ionic radii, ionization energy, electronic affinity and electronegativity.
3. Illustrate the fundamental concepts of organic chemistry and the reactive intermediates involves through the reaction.
4. Explain the various methods of preparations and reactions of aliphatic hydrocarbons like alkanes, alkenes and alkynes which is the important part of organic synthesis
5. Illustrate the concept of rate of a reaction, factors influencing the rate of a reaction, Arrhenius equation and their numericals.

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 12 marks each. Section C will consist of 11 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting two questions each of A & B sections. Section C is compulsory.

Section – A

Atomic Structure

Idea of de-Broglie matter waves, derivation of de- Broglie equation, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, the significance of ψ and ψ^2, quantum numbers, radial and angular wave functions (excluding mathematical relations), probability distribution curves in terms of R(r) vs r and R(r) vs r^2 (for 1s, 2s 3s and 2p, 3p, 4p subshells), shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's rule of multiplicity. Electronic configurations of the elements and ions (Atomic number upto 30).

Periodic Properties

Position of elements in the periodic table, effective nuclear charge and its calculations. Atomic and ionic radii, ionization energy, electronic affinity and electronegativity-definition, methods of determination or evaluation, trends in periodic table.

Structure and Bonding
Hybridization, Bond length and bond angles, Bond Energy, Localized and Delocalized chemical bond, Van der Waal's interaction (dipole-dipole; dipole-induced dipole; induced dipole - induced dipole interactions), Resonance, Hyperconjugation, Inductive and Hydrogen Bonding.

Reaction Intermediates
Curved arrow notation, Drawing electron movements with arrows, half-headed and double headed arrows, hemolytic and heterolytic bond breaking, Types of reagents (Types, structure and stability) -Electrophiles and Nucleophiles, Reactive intermediates-Carbocations, Carbanions, Free Radicals.

Section -B

Alkanes
Structure, IUPAC Nomenclature, and Isomerism. Methods of Preparation (from alkyl halide, Wurtz reaction, Corey-House synthesis), Physical properties, Halogenation of alkanes and its mechanism -Relative reactivities of halogens, and different classes of hydrogen atoms; Reactivity, and Selectivity.

Chemical Kinetics
Chemical kinetics and its scope, Rate of a reaction, factors influencing the rate of a reaction (qualitative analysis only) - concentration, temperature, pressure, solvent, light, catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions zero order, first order, second order, pseud order, half-life, and mean life. Determination of the order of reaction - differential method, method of integration, method of half-life period, and isolation method. Radioactive decay as a first-order phenomenon (only numericals).

Chemical Kinetics-II
Theories of Chemical Kinetics, Effect of temperature on rate of reaction, Arrhenius equation (without derivation), concept of activation energy (graphical representation for exothermic and endothermic reactions). Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant.

Books Recommended

1. *Quantum chemistry and molecular spectroscopy.* KL Kapoor
2. *Quantum chemistry: through problem solving and solutions*: RK Parsad
3. *Chemical structure and Bonding*: Roger L. dedock Hary B. Gray
4. *Atomic structure and chemical bond*: A problem solving approach: Manas Chanda
5. *Reactive Intermediate in organic chemistry:* Structure, Mechanism and Reaction Maya Shankar Singh, Wiley VCH
6. *Intermediate Organic chemistry:second edition:* John C Stowell
7. *Puri Sharma Pathania* Principles of Physical Chemistry

CHEMB 1104P: PRACTICAL CHEMISTRY -I (For Minor)

Max Marks: 50 marks **Credits: 01**
Semester Paper: 35 marks **Time allowed - 3 hrs**
Internal Assessment: 15 marks **02 hours/week**
Pass Marks: 35%

INSTRUCTIONS FOR THE PAPER SETTERS, EXAMINERS & CANDIDATES

The Practical Examinations will be held in the one morning session (one day) that will be of 3 hours duration. During this session students will perform following two types of experiments:
(a). Semi micro analysis along with
(b). Crystallization of the given sample.
Paper setter will enlist five different mixtures and the examiner will randomly distribute these mixtures amongst the students. Each candidate will analyze one mixture along with crystallization of the given sample. Students are permitted to consult the books for the scheme of tests for semimicro analysis.

PRACTICAL EXERCISE

SEMI-MICRO ANALYSIS:

Cation analysis, separation, and identification of ions from Groups I, II, III, IV, V and VI. Anion analysis (2 cations and 2 anions with no interference).

CRYSTALLIZATIONS:

(i) Phthalic acid from hot water;
(ii) Acetanilide from boiling water;
(iii) Naphthalene from ethanol;
(iv) Benzoic acid from water.

DETAILS OF DISTRIBUTION OF MARKS

1.	Semi-Micro analysis:	15 Marks
2.	Crystallization:	05 Marks
3.	Viva-voce:	10 Marks
4.	Practical NoteBook	05 Marks
5.	Total Marks	35 Marks

Books Recommended

1. *Vogel's Qualitative Inorganic Analysis,* revised, Svehla, Orient Longman.
2. *Vogel's Textbook of Quantitative Inorganic Analysis* (revised), J. Basseff, R.C. Dennery, G.H. Jeffery and J. Mendham, ELBS.
3. *Standard Methods of Chemical Analysis,* W.w. Scott the Technical Press.
4. *Experimental Inorganic Chemistry:* W.G. Palmer, Cambridge.
5. *Modern Practical chemistry:* S. Kiran Kavya

BCHE1105T: CHEMISTRY IN DAILY LIFE (IDC)

Max Marks: 100 marks **Credits: 03**
Semester Paper: 70 marks **Total Lectures: 60 hrs**
Internal Assessment: 30 marks **03 hours/week**
Pass Percentage: 35%

COURSE OBJECTIVES:

1. Make them aware of the Chemistry of products used in daily life.
2. To get information about the connection between Chemistry and environmental impact, health care, nutrition, etc.
3. To make right choice of house hold products.

COURSE OUTCOMES:

At the end of the course, students will be able to:

1. Understand the Chemistry of the products used in daily life.
2. To get knowledge of basic medicines and their action in our body.
3. Understand the advantages and disadvantages of the products used in daily life.
4. Knowledge enhancement of carbohydrates, proteins and vitamins.
5. Understand common adulterants in food items.

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 12 marks each. Section C will consist of 11 short answer questions that will cover the entire syllabus and will be of 2 marks each.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting two questions each of A & B sections. Section C is compulsory.

Section – A

Chemistry of Medicines: Classification, types, designing and nomenclature of drugs, interaction of drugs with targets and receptors, neurological active drugs, antipyretics, analgesics, antacids, antihistamines, antifertility drugs, antimicrobials, antiseptics and disinfectants, broad and narrow spectrum antibiotics.

Chemistry of the Cleaning Agents: Soaps and detergents, mechanism of cleansing action of soaps and detergents, biodegradable and non-biodegradable detergents.

Section – B

Carbohydrates: Structure, function and Chemistry of some important mono, di and polysaccharides. Reducing, non- reducing sugars and importance of carbohydrates.

Vitamins: Classification, sources, deficiency diseases of vitamin A, D, E, K, B_{12} and C.

Proteins: classification, primary, secondary, tertiary and quaternary structure, denaturation and renaturation of proteins.

Common Adulterants in Different Foods: Milk and milk products, Vegetable oils, Cereals, Tea and Coffee powder, Chilly powder, Beverages

Books Recommended:

1. General Chemistry (XI and XII) and Engineering Chemistry (Part I).
2. Medicinal Chemistry by Asutosh Kar, New Age International P. Ltd.
3. Drugs and Pharmaceuticals Sciences Series, Marcel Dekker, Vol. II, INC, New York.
4. Analysis of Foods – H.E. Cox: 13. Chemical Analysis of Foods – H.E.Cox and pearson.
5. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4th ed. New Age International (1998).
6. Lillian Hoagland Meyer, Food Chemistry, 1st Edn., CBS Publishers & Distributors, New Delhi, 2004.
7. Food Safety and Standards Authority of India adulteration testing manual 2019.

BCHE1106T: Chemistry of Cosmetics and Perfumes (SEC)

Max Marks: 100 marks
End Semester Exam: 70 marks
Internal Assessments: 30 marks
Pass Marks: 35%

Credits: 03
Total Lectures: 60 hours
3 hours/week

COURSE OBJECTIVES:

1. Understand perfume chemistry and formulation.
2. Learn cosmetic and cosmeceutical basics.
3. Explore skincare and haircare product chemistry.
4. Appreciate characterization techniques and safety standards.

COURSE OUTCOMES:

1. Identify and describe major classes of cosmetic and fragrance ingredients, articulating their role in product performance.
2. Explain the chemistry and classification of fragrances, including extraction methods, and differentiate between natural and synthetic sources.
3. Formulate and prepare personal-care products (e.g., shampoos, creams, lotions, lipsticks) following standard lab protocols.
4. Perform testing and analysis of cosmetic and fragrance formulations using techniques such as TLC, GC, viscosity measurement, pH testing, and stability testing.

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 12 marks each. Section C will consist of 11 short answer questions that will cover the entire syllabus and will be of 2 marks each.

INSTRUCTIONS FOR STUDENTS

Students are required to attempt five questions selecting two questions from each of Section A & B while Section C is Compulsory.

Section-A

PERFUMES

Introduction to perfumes, history, classification of perfumes, the concept of aroma, types and physiological effects. Composition, formulation and working mechanism of perfume. Antiperspirants and deodorants: definition, working mechanism, composition, formulation chemistry and comparison. Introduction to perfumery chemicals: Natural sources, natural identical and synthetic compounds. Extraction methods of perfumery chemicals. Examples of some important perfumery chemicals (synthesis, properties and chemistry)

CHEMISTRY OF COSMETICS-I

Introduction to cosmetics: Definition, history and application. Cosmetology, Introduction to cosmeceuticals. Anatomy of skin and hair with respective to cosmetology. Classification of cosmetics. Physiological effects of cosmetics. Cosmeceuticals: definition, chemicals, mechanism of action. Induction to oral care products. Example: 8/20 materials used in skin, nail care products and their function. Chemistry of ma. Cosmeceuticals

Section-B

CHEMISTRY OF COSMETICS-II

Introduction to skin care cosmetics: classification, chemicals, properties, physiological effects. Study chemistry of some skin care products (creams, foundation, primer, lotions). Chemistry of nail polish and paints. Hair care products: Properties, classification, working mechanism, formulation, safety and chemistry of hair care products (shampoo, conditioner, gels, coloring agents etc.)

CATALYTIC PROCESSES

Introduction to herbal cosmetics. Characterization of cosmetics and perfumes (Chromatography, physical methods, spectroscopy). Safety and testing of cosmetics and perfumes. Regulatory and quality control of cosmetics. Modern developments in cosmetic chemistry. Cosmetic surgery and related studies

TEXT/REFERENCE BOOKS

1. Hilda Butler (editor), Poucher's Perfumes, Cosmetics, and Soaps 10th edition, Dordrecht: Kluwer Academic Publishers 2010.
2. "Chemistry and Technology of the Cosmetics and Toiletries Industries", by D.F. Williams, Springer International Edition.
3. Anthony J. O'Lenick Jr.; Thomas G. O'Lenick, Organic chemistry for cosmetic chemists, Carol Stream, IL: Allured Publishing, 2008
4. Beginning Cosmetic Chemistry by Schueller and Romanowsk, Allured Pub Corp; 3rd edition, 20089
5. Barel AO, Paye M, Maibach HI. Handbook of cosmetic science and technology. CRC

BCHE1201T: CHEMISTRY MAJOR-II

Max Marks: 100 marks **Credits:03**
Semester Paper: 70 marks **Time allowed - 3 hrs**
Internal Assessment: 30 marks **Total lectures: 60 hrs**
Pass Marks: 35%

COURSE OBJECTIVES:

1. To emphasize on atomic structure, bonding and periodicity of elements.
2. To understand the general concepts of stereochemistry of organic compounds.
3. To understand the significance of the kinetic molecular theory of gases.

COURSE OUTCOMES:

1. Explain the theoretical treatment of chemical bonding via valence bond theory and VSPER.
2. Understand and distinguish between geometrical and optical isomerism and analyse the stereochemistry of various organic moieties.
3. Illustrate the fundamental concepts of organic chemistry and importance of stereochemistry in organic molecules.
4. Define and explain the concept of thermodynamics and thermochemistry. Formulate the law of thermodynamics for open and closed systems.

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 12 marks each. Section C will consist of 11 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting two questions each of A & B sections. Section C is compulsory.

Section A

Chemical Bonding-I

Covalent Bond - Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization, and shapes of simple inorganic molecules and covalent ions: BeF_2, CH_4, PF_5, SF_6, Valence shell electron pair repulsion (VSEPR) theory to H_3O^+, SF_4 and H_2O. Percentage of ionic character from dipole moment and electronegativity.

Chemical Bonding - II

Ionic Solids - Concept of close packing, ionic structures (NaCl type, and Zinc blende), radius ratio rule and coordination number, limitation of radius ratio rule, lattice defects, semiconductors.

Geometrical and Conformational Isomerism

Concept of Isomerism. Types of isomerism. Cause and conditions for geometrical isomerism. Nomenclature of geometrical isomers- cis & trans, E and Z system. Determination of the configuration of geometrical isomers. Representation of conformations (ethane and n-butane) - Sawhorse and Newman formulae. Conformational analysis of ethane and n-butane.

Section B

Stereochemistry of Organic Compounds - Optical Isomerism

Tetrahedral concept of carbon, specific rotation. Optical isomerism: Enantiomerism, stereogenic center, optical activity, chiral and achiral molecules with one stereogenic centers, Diastereoisomers, Erythro and Threo isomers, Meso compounds. Representation of Stereoisomers - Flying edge, and Fischer Projection.

Relative and absolute configuration, sequence rules, D & L, and R & S system of nomenclature (with one centre acyclic system).

Gaseous States

Gas laws (Boyel's, Charles, Avogadros), Ideal and real gases, postulates of kinetic theory of gases, deviation from ideal behavior, Van der Waals equation of state - qualitative analysis, significance of a and b. Critical Phenomena: PV isotherms of real gases (Elementary Idea only), the isotherms of Van der Waals equation, relationship between critical constants and Van der Waals constants (expression and their variations only), the law of corresponding states, reduced equation of state - its expression and importance. Molecular Velocities: Root mean square, average, and most probable velocities (definition, expression and their relation). Collision number, mean free path, and collision diameter. Liquefaction of gases (a case study of CO2).

Thermodynamics I

Definition of Thermodynamic Terms: System, surroundings and universe. Types of systems: open close, adiabatic, intensive and extensive properties (examples and difference). State and path functions. First Law of Thermodynamics: Statement, definition of internal energy and enthalpy, Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's Law - Joule-Thomson coefficient and inversion temperature (expression and explanation).

Books Recommended

1. *Structure and Bonding 26:* spectra and chemical intraction, Springer verlag Berlin Heldelberg GmbH
2. Chemical Bonding, Dr. Jaidev Kumar
3. Sterochemistry Conformation and Mechanism,Tenth edition, P S Kalsi
4. Sterochemistry with application to organic reactions, Jagdamba Singh, L D S Yadav Jaya Singh, Santosh Singh
5. Basic thermodynamics, P.B. Nagaraj d. Venkatesh
6. Thermodynamics concept and application: second Edition Stephen R. Turns Laura L Pauley
7. Chemistry of Gaseous state; M.S. Yadav

CHEMB 1202P: PRACTICAL CHEMISTRY-II (For Major)

Max Marks: 50 marks **Credits:01**
Semester Paper: 35 marks **Time allowed - 3 hrs**
Internal Assessment: 15 marks **02 hours/week**
Pass Marks: 35%

COURSE OBJECTIVES:

1. To provide students with hands-on experience and a practical understanding of the theoretical concepts learned in the course.
2. To develop essential laboratory skills in chemical analysis, problem-solving and gaining a deeper understanding of chemical principles.

COURSE OUTCOMES:

1. Students learn how to record, analyze, and present their experimental data accurately.
2. Student will learn techniques to determine melting and boiling points of different compounds.
3. To study kinetics of reactions.
4. Students will learn to determine viscosity, surface tension and molecular weights.

INSTRUCTIONS FOR THE PAPER SETTERS EXAMINERS/CANDIDATES

In this session in morning students will perform physical and organic chemistry practicals. Examiner will again conduct viva-voce of students.

(a) The examiner should preferably give different liquids solids to the candidates for the determination of boiling point/melting point and crystallization from the list of liquids/solids by the paper setter.
(b) The paper setter will provide a list of five physical chemistry experiments. The examiner will allot one experiment randomly to each candidate. The candidate will write theory, brief procedure and general calculations of the experiment in the first 10 minutes and thereafter perform the actual experiment.

PRACTICAL EXERCISE

LABORATORY TECHNIQUES

Determination of melting points:

a) Naphthalene (80-82 °C), b) Benzoic acid (121.5-122 °C), c) Urea (132.5-133 °C), d) Cinnamic acid (132.5-133 °C), e) Salicylic acid (157.5-158 °C), f) Acetanilide (113.5-114°C), g) m-Dinitrobenzene (88-90 °C), h) p-Dichlorobenzene (50-52 °C)

Determination of boiling points

Ethanol 78 °C, Cyclohexane 81.4 °C. Toluene 110.6 °C, Benzene 80 °C.

PHYSICAL CHEMISTRY EXPERIMENT

Chemical Kinetics

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.
3. Viscosity & Surface Tension of pure liquids.
4. To determine the viscosity and surface tension of C_2H_5OH and glycerin solution in water
5. Molecular weight determined by Rast method.

DETAILS OF DISTRIBUTION OF MARKS

1) Melting point/boiling point/crystallization	10 marks
2) Physical chemistry experiment	
a) Initial write up	7 marks
b) Performance	8 marks
3) Viva-voce	5 marks
4) Note Book	5 marks

BOOKS SUGGESTED:

1. *Physical Chemistry Laboratory Manual* by B.D. Khosla, V.C. Garg, and A. Gulati
2. *Practical Physical Chemistry* by B. Viswanathan and P.S. Raghavan
3. *Experiments in Physical Chemistry* by Shoemaker, Garland, Nibler
4. *Vogel's Textbook of Practical Organic Chemistry by A.I. Vogel*
5. *Laboratory Manual of Organic Chemistry* by B.S. Bahl & Arun Bahl
6. *A Textbook of Practical Organic Chemistry* by O.P. Pandey, D.N. Bajpai, S. Giri

BCHE1203T: CHEMISTRY MINOR-I

Max Marks: 100 marks **Credits:03**
Semester Paper: 70 marks **Time allowed - 3 hrs**
Internal Assessment: 30 marks **Total lectures: 60 hrs**
Pass Marks: 35%

COURSE OBJECTIVES:

1. To emphasize on atomic structure, bonding and periodicity of elements.
2. To understand the general concepts of stereochemistry of organic compounds.
3. To understand the significance of the kinetic molecular theory of gases.

COURSE OUTCOMES:

1. Explain the theoretical treatment of chemical bonding via valence bond theory and VSPER.
2. Understand and distinguish between geometrical and optical isomerism and analysis the stereochemistry of various organic moieties.
3. Illustrate the fundamental concepts of organic chemistry and importance of stereochemistry in organic molecules.
4. Define and explain the concept of thermodynamics and thermochemistry. Formulate the law of thermodynamics for open and closed systems.

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 12 marks each. Section C will consist of 11 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions selecting two questions each of A & B sections. Section C is compulsory.

Section A

Chemical Bonding-I

Covalent Bond - Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization, and shapes of simple inorganic molecules and covalent ions: BeF_2, CH_4, PF_5, SF_6, Valence shell electron pair repulsion (VSEPR) theory to H_3O^+, SF_4 and H_2O. Percentage of ionic character from dipole moment and electronegativity.

Chemical Bonding - II

Ionic Solids - Concept of close packing, ionic structures (NaCl type, and Zinc blende), radius ratio rule and coordination number, limitation of radius ratio rule, lattice defects, semiconductors.

Geometrical and Conformational Isomerism

Concept of Isomerism. Types of isomerism. Cause and conditions for geometrical isomerism. Nomenclature of geometrical isomers- cis & trans, E and Z system. Determination of the configuration of geometrical isomers. Representation of conformations (ethane and n-butane) - Sawhorse and Newman formulae. Conformational analysis of ethane and n-butane.

Section B

Stereochemistry of Organic Compounds - Optical Isomerism

Tetrahedral concept of carbon, specific rotation. Optical isomerism: Enantiomerism, stereogenic center, optical activity, chiral and achiral molecules with one stereogenic centers, Diastereoisomers, Erythro and Threo isomers, Meso compounds. Representation of Stereoisomers - Flying edge, and Fischer Projection.

Relative and absolute configuration, sequence rules, D & L, and R & S system of nomenclature (with one centre acyclic system).

Gaseous States

Gas laws (Boyel's, Charles, Avogadros), Ideal and real gases, postulates of kinetic theory of gases, deviation from ideal behavior, Van der Waals equation of state - qualitative analysis, significance of a and b. Critical Phenomena: PV isotherms of real gases (Elementary Idea only), the isotherms of Van der Waals equation, relationship between critical constants and Van der Waals constants (expression and their variations only), the law of corresponding states, reduced equation of state - its expression and importance. Molecular Velocities: Root mean square, average, and most probable velocities (definition, expression and their relation). Collision number, mean free path, and collision diameter. Liquefaction of gases (a case study of CO2).

Thermodynamics I

Definition of Thermodynamic Terms: System, surroundings and universe. Types of systems: open close, adiabatic, intensive and extensive properties (examples and difference). State and path functions. First Law of Thermodynamics: Statement, definition of internal energy and enthalpy, Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's Law - Joule-Thomson coefficient and inversion temperature (expression and explanation).

Books Recommended

1. *Structure and Bonding 26:* spectra and chemical intraction, Springer verlag Berlin Heldelberg GmbH
2. Chemical Bonding, Dr. Jaidev Kumar
3. Sterochemistry Conformation and Mechanism,Tenth edition, P S Kalsi
4. Sterochemistry with application to organic reactions, Jagdamba Singh, L D S Yadav Jaya Singh, Santosh Singh
5. Basic thermodynamics, P.B. Nagaraj d. Venkatesh
6. Thermodynamics concept and application: second Edition Stephen R. Turns Laura L Pauley
7. Chemistry of Gaseous state; M.S. Yadav

CHEMB 1204P: PRACTICAL CHEMISTRY-II (For Minor)

Max Marks: 50 marks **Credits:01**
Semester Paper: 35 marks **Time allowed - 3 hrs**
Internal Assessment: 15 marks **02 hours/week**
Pass Marks: 35%

COURSE OBJECTIVES:

1. To provide students with hands-on experience and a practical understanding of the theoretical concepts learned in the course
2. To develop essential laboratory skills in chemical analysis, problem-solving and gaining a deeper understanding of chemical principles.

COURSE OUTCOMES:

1. Students learn how to record, analyze, and present their experimental data accurately.
2. Student will learn techniques to determine melting and boiling points of different compounds.
3. Students will learn to determine viscosity, surface tension and molecular weights

INSTRUCTIONS FOR THE PAPER SETTERS EXAMINERS/CANDIDATES

In this session in morning students will perform physical and organic chemistry practicals. Examiner will again conduct viva-voce of students.

a) The examiner should preferably give different liquids solids to the candidates for the determination of boiling point/melting point and crystallization from the list of liquids/solids by the paper setter.
b) The paper setter will provide a list of five physical chemistry experiments. The examiner will allot one experiment randomly to each candidate. The candidate will write theory, brief procedure and general calculations of the experiment in the first 10 minutes and thereafter perform the actual experiment.

PRACTICAL EXERCISE

LABORATORY TECHNIQUES

Determination of melting points:

a) Naphthalene (80-82 °C), b) Benzoic acid (121.5-122 °C), c) Urea (132.5-133 °C), d) Cinnamic acid (132.5-133 °C), e) Salicylic acid (157.5-158 °C), f) Acetanilide (113.5-114°C), g) m-Dinitrobenzene (88-90 °C), h) p-Dichlorobenzene (50-52 °C)

Determination of boiling points

Ethanol 78 °C, Cyclohexane 81.4 °C. Toluene 110.6 °C, Benzene 80 °C.

PHYSICAL CHEMISTRY EXPERIMENT

Chemical Kinetics

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.

3. Viscosity & Surface Tension of pure liquids.
4. To determine the viscosity and surface tension of C_2H_5OH and glycerin solution in water
5. Molecular weight determined by Rast method.

DETAILS OF DISTRIBUTION OF MARKS

1) Melting point/boiling point/crystallization	10 marks
2) Physical chemistry experiment	
a) Initial write up	7 marks
b) Performance	8 marks
3) Viva-voce	5 marks
4) Note Book	5 marks

BOOKS SUGGESTED:

1. *Physical Chemistry Laboratory Manual* by B.D. Khosla, V.C. Garg, and A. Gulati
2. *Practical Physical Chemistry* by B. Viswanathan and P.S. Raghavan
3. *Experiments in Physical Chemistry* by Shoemaker, Garland, Nibler
4. *Vogel's Textbook of Practical Organic Chemistry by A.I. Vogel*
5. *Laboratory Manual of Organic Chemistry* by B.S. Bahl & Arun Bahl
6. *A Textbook of Practical Organic Chemistry* by O.P. Pandey, D.N. Bajpai, S. Giri

BCHE1205T: BASIC ANALYTICAL CHEMISTRY (IDC/MDC)

Max. Marks: 100 **Credits: 03**
End semester Exam: 70 marks **Total Lecture: 60 hrs**
Internal Examination: 30 marks **03 hours/ week**
Pass Marks: 35%

COURSE OBJECTIVES:

1. To introduce the fundamental concepts and methods of sampling solids, liquids, and gases.
2. To provide theoretical and practical knowledge of volumetric (titrimetric) methods including acid-base, redox, precipitation, and complexometric titrations.
3. To impart knowledge of UV-Visible and IR spectroscopy principles, instrumentation, and analytical applications.
4. To introduce chromatographic separation techniques with a focus on TLC and HPLC methodologies.

COURSE OUTCOMES:

1. Understand principles and techniques of sampling for different states of matter.
2. Evaluate analytical data using statistical tools for precision, accuracy, and error analysis.
3. Understand and apply various titrimetric methods including acid-base, redox, precipitation, and complexometric titrations.
4. Interpret UV-Visible and IR spectra for structural analysis of simple organic compounds.
5. Understand and apply chromatographic techniques like TLC and HPLC for component separation and analysis.

INSTRUCTIONS FOR PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 12 marks each. Section C will consist of 11 short answer questions that will cover the entire syllabus and will be of 2 marks each.

INSTRUCTIONS FOR STUDENTS

Students have to attempt total four questions from section A and B selecting two questions from each section. Section C will be compulsory.

Section A

Sampling and Analytical Data Evaluation: Sampling: Definition and objectives of sampling, Theory and principles of sampling, Types of sampling methods, Sampling techniques for solids, liquids, and gases.

Replicate Analysis and Data Reliability: Importance of replicate analysis, Reliability and validity of analytical data

Statistical Treatment of Data: Measures of central tendency: mean and median; Measures of dispersion: range, precision, and accuracy; Expression of precision and accuracy using: Deviation, Mean deviation, Relative mean deviation, Standard deviation

Errors in Analysis: Definition and types of errors, Absolute and relative errors, Determinate errors, classification of determinate errors and their minimization, indeterminate error.

Volumetric Analysis and Titrimetric Methods

Neutralisation Reactions (Acid-Base Titrations): Theory of acid-base titrations, Selection and theory of acid-base indicators.
Redox Titrations: Redox potentials and their significance, Principles and feasibility of redox titrations. Redox indicators: their choice and applications.
Precipitation Titrations: Theory and classification of precipitation titrations, Mohr, Volhard, and Fajans methods, Adsorption indicators: theory, choice and applications.
Complexometric Titrations: Basic theory and titrations involving metal chelates, particularly EDTA

Section –B

UV-Visible spectroscopy: Basic principles of UV-Visible spectroscopy, Instrumentation and working of UV-VIS spectrophotometers, Types of electronic transitions ($\sigma\rightarrow\sigma^*$, $n\rightarrow\sigma^*$, $\pi\rightarrow\pi^*$, $n\rightarrow\pi^*$), Lambert Beer's Law and its limitations, Auxochrome & Chromophore, Bathochromic, hypsochromic, hyperchromic and hypochromic shift.
Infrared (IR) Spectroscopy: Introduction to IR spectroscopy, theory and instrumentation, selection rules, fingerprint region, factors affecting molecular vibrations.
Chromatography
Thin Layer Chromatography (TLC): Principle and working of TLC, Chromatographic media and coating materials, Activation of adsorbents, sample development, solvent systems, development of chromatoplate.
High Performance Liquid chromatography (HPLC): principle, technique and applications.

BOOKS SUGGESTED-PRACTICAL COURSES:

1. *Vogel's Qualitative Inorganic Analysis*, revised, Svehla, Orient Longman.
2. *Vogel's Texibook of Quantitative Inorganic Analysis (revised)*, J. Basseff, R.C. Dennery, G.H. Jeffery and J. Mendham, ELBS.
3. *Standard Methods of Chemical Analysis*, W. Scott the Technical Press.
4. *Quantitative Chemical Analysis* by Daniel C. Harris
5. *Analytical Chemistry* by Gary D. Christian
6. *Theory and Practice of Modern Analytical Chemistry* by David Harvey
7. *Principles of Instrumental Analysis* by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch
8. *Introduction to Spectroscopy* by Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James R. Vyvyan
9. *Chromatography: Concepts and Contrasts* by James M. Miller

BCHE1206T: Chemistry of Drugs (SEC)

Max Marks: 100 marks **Credits: 03**
Semester Paper: 70 marks **Total Lectures: 60 hrs**
Internal Assessment: 30 marks **03 hours/week**
Pass Percentage: 35%

COURSE OBJECTIVES:

1. To provide foundational knowledge of drug classification based on therapeutic action.
2. To understand the mechanism, application, and examples of chemotherapeutic, pharmacodynamic, and metabolic process drugs.
3. To explore the role of vitamins and hormones in human health and their clinical relevance.

COURSE OUTCOMES:

1. Classify drugs based on therapeutic categories and their mode of action.
2. Explain the mechanism and use of chemotherapeutic agents like antimalarials, antibiotics, and antitubercular drugs.
3. Describe pharmacodynamic agents affecting the CNS, PNS, cardiovascular, and renal systems.
4. Identify drugs acting on metabolic processes, including essential vitamins and their deficiency effects.
5. Understand the physiological role and therapeutic use of hormones like insulin, estrogen, and testosterone.
6. Correlate drug action with clinical applications and patient outcomes.

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 12 marks each. Section C will consist of 11 short answer questions that will cover the entire syllabus and will be of 2 marks each.

INSTRUCTIONS FOR STUDENTS

Students are required to attempt five questions selecting two questions from each of Section A& B while Section C is Compulsory.

Section- A

General Introduction of Drugs

Introduction: Diseases- causes of diseases, Drug- definition and sources. ADME of drugs (brief) - Absorption, distribution, drug metabolism (in liver), elimination (brief), Toxicity. Examples (i) Zintac (Ranitidine, antacid) (ii) Paracetamol (antipyretic) (iii) Benadryl (Cough syrup). Characteristics of an ideal drug. Nomenclature of Drugs: Chemical name- generic name- trade name. Trade names for the given generic names- (i) Aspirin (ii) Amoxycillin (iii) Ciprofloxacin (iv) Paracetamol (v) Mebendazole Drug formulations: Definition- need for conversion of drug into pharmaceutical (drug formulations) - Additives- diluents, binders, lubricants, antioxidants, flavourants, sweeteners, colourants, coating agents. Classification of drug formulations: oral, parental and topical dosage forms advantages and disadvantages

Oral Dosage forms: Tablets (Aspirin- analgesic; Ciprofloxacin- antibacterial). Capsules (Amoxycillin- antibiotic; Omeprazole- antacid) Syrups (B-complex syrup; benadryl- Cough syrup).

Section-B

Classification of Drugs: Classification of Drugs based on therapeutic actions- Chemotheropeutic agents, Pharmacodynamic agents and drugs acting on metabolic processes. Brief explanation for the following drug with their utilities only:

(i) **Chemotherapeutic agents:** Antimalarials- Chloroquine; Antibiotic- Amoxicillin; Antitubercular drugs- isoniazide; Antiprotozoals- metronidazole.

(ii) **Pharmacodynamic agents**

(a) Drugs acting on CNS: Diazepam (CNS depressant), General anesthetic (thiopental sodium), antipyretic and analgesic (Ibuprofen) (b) Drugs acting on PNS: local anesthetics (Benzocaine) (c) Drugs acting on cardiovascular system: Metoprolol (antihypertensive agents), Nefidipine (antianginal and antihypertensive agent) (d) Drugs acting on renal system: Diuretics (Acetazolamide)

(iii) **Drugs acting on metabolic processes**

(a) Vitamins: Common name, source, deficiency, Vitamin A, B2, B6, C, D, E and K- remedy
(b) Hormones: Function (brief)- deficiency of hormones (Insulin, Testosterone and Osterone)

Recommended Text Books and Reference Books

1. *Industrial Chemistry, Vol -I,* E. Stocchi, Ellis Horwood Ltd. UK.
2. *Engineering Chemistry*, P.C. Jain, M. Jain, Dhanpat Rai & Sons, Delhi.
3. *Industrial Processing Chemistry*, Sharma, B.K. & Gaur, H., Goel Publishing House, Meerut (1996).
4. *Food Processing and Impact on Nutrition*, Rameen Devi, Sc J Agric Vet Sci.,Aug-Sep 2015; 5. Perfumes, Cosmetics and Soaps, W.A. Poucher, (1993).
5. *A first course in food analysis* by A Y Sathe
6. *Food Science* by N.Potter, CBS publishers
7. *Food chemistry*, Lillian Hoagland Meyer, (2008).
8. *A Handbook of food packaging* by F. A. Paine and H.Y. Paine.
9. *Fundamental Applied Chemistry concepts of applied chemistry* by J.C Ghosh, S. Chand and Co, Ltd, New Delhi.
10. *Applied Chemistry* by K .Bhagavathi Sundhar, MJP publishers.
11. *Drugs* by G.L.David Krupadanam, D.Vijaya Prasad, K.Varaprasad Rao, K.L.N.Reddy, C.Sudhakar, Universities Press (India) Limited 2007
12. *An Introduction to Medicinal Chemistry* by Graham L. Patrick, Oxford University Press, New York 1995