S.S. Jain Subodh P.G. College (Autonomous), Jaipur

BACHELOR OF SCIENCE
Chemistry

Semester I

Semester Scheme

Paper Code	Paper title	Course Category	Credit	Total contact hours per semester / per week		Maximum marks	Minimum marks	ESE in hrs	
								Theory	Practical
BCHE 101	Inorganic and Organic Chemistry-I	DSC	2	30	2	50	20	3	-
BCHE 102	Organic and Physical Chemistry-I	DSC	2	30	2	50	20	3	-
BCHE 151	Chemistry Practical I	DSCP	2	60	4	50	20	-	4
			6		8				

The details of the courses with code and title assigned are given below:
DSC= Discipline Specific Core ESE = End Semester Examination DSCP= Discipline Specific Core Practical

Examination Scheme

S.No.	Paper	ESE	CIA	Total
1.	Theory	70%	30%	100%
2.	Practical	60%	40%	100%

Syllabus of each theory paper is divided into four units.
Each theory paper is of 3 hours duration . Each Practical /Lab work is of 4 hours duration .

The number of papers and the maximum marks for each paper/ practical is shown in the syllabus for the paper concerned. It will be necessary for a candidate to pass in theory as well as practical of a subject separately.

Note: Maximum marks for a theory paper is 50 which includes 35 marks for ESE and 15 marks for internal assessment. Maximum marks for a practical paper is which includes 30 marks for ESE and 20 marks for internal assessment.

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BACHELOR OF SCIENCE
Chemistry

Semester I

Evaluation Scheme

Theory Paper

Max. hrs: 3 hrs. Max. Marks: 50

PART A	Comprises of ten very short answer questions from all units. (It is compulsory to attempt any 7questions)	7x1= 7 Marks
PART B	Comprises of eight long answer questions with two questions from each unit. Candidates have to answer any four questions, selecting one question from each unit.	4x7 = 28 Marks
	Total marks for End Semester Examination	**35 Marks**
	Internal Assessment	**15 Marks**
	Total	**50 Marks**

Practical Paper

Max. hrs: 4 hrs. Max. Marks: 50

Experiment no. 1	Inorganic Chemistry	10 Marks
Experiment no. 2	Physical Chemistry	10 Marks
	Record	5 Marks
	Viva	5 Marks
	Total marks for End Semester Examination	**30 Marks**
	Internal Assessment	**20 Marks**
	Total	**50 Marks**

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BACHELOR OF SCIENCE
Chemistry

Semester I

Paper I

BCHE 101 **Inorganic and Organic Chemistry-I** **30 Hrs (2 hrs/week)**

Unit -I
Chemical Bonding I and Periodicity of s-Block Elements

Chemical Bonding I: Covalent bond: properties and directional characteristics, hybridization and shapes of different molecules and ions, Valence Shell Electron Pair Repulsion (VSEPR) theory for H_2O, H_3O^+, NH_3, SF_4, ClF_3, ICl_2^-, Valance Bond Theory and its limitations.

Periodicity of s-Block elements: Atomic and ionic radii, Ionization potential, Electronegativity, density, melting points and boiling points, diagonal relationship, solvation and complexation tendencies including their functions in biosystem.

Unit-II
Chemical Bonding II and Hydrogen Bonding

Chemical bonding II: Linear combination of atomic orbitals, types of molecular orbitals,, molecular orbital theory for homonuclear molecules and ions (H_2^+ - Ne_2), Molecular Orbital Theory for heteronuclear molecules and ions (HF, CO, NO, NO^+) , comparison of Valence Bond Theory and Molecular Orbital Theory, multicentre bonding in electron deficient molecules.

Hydrogen bonding: Characteristics of Hydrogen bond, factors affecting Hydrogen bond, theories of Hydrogen bond formation, types of hydrogen bonding and its consequences.

Unit-III
Mechanism of Organic Reactions

Mechanism of organic reactions: Curved arrow notation, homolytic and heterolytic bond cleavage, types of reagents: electrophiles and nucleophiles. Types of organic reactions, reactive intermediates-carbocations, carbanions, free radicals, carbenes, arynes and nitrenes with examples. Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effect, kinetic and stereo chemical studies).

Unit-IV
Alkanes and Cycloalkanes

Alkanes: IUPAC nomenclature of branched and unbranched alkanes, isomerism in alkanes sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey House reaction and decarboxylation of carboxylic acids.) Physical properties and chemical reactions of alkanes, mechanism of free radical halogenations of alkanes, orientation, reactivity and selectivity.

Cycloalkanes: Nomenclature, methods of formation, chemical reactions, Baeyer Strain Theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring: banana bond.

Learning Outcomes:

Students will be able to:

- learn about chemical bonding, hybridization and draw shapes and geometrics of various inorganic molecules.
- understand the basic concept of organic reaction mechanism and saturated aliphatic hydrocarbons, their structures, physical and chemical properties.

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BACHELOR OF SCIENCE
Chemistry

Semester I

Paper II

BCHE 102 **Organic and Physical Chemistry-I** **30 Hrs (2 hrs/week)**

Unit-I
Stereochemistry-I

Stereochemistry of organic compounds: Concept of isomerism, Optical isomerism; elements of symmetry, molecular chirality- allenes and biphenyl, enantiomers, stereogenic centre, optical activity, properties of enantiomers. Chiral and achiral molecules with two stereogenic centres, distereomers threo, and erythro diastereomers, meso compounds. Resolution, inversion, retention and racemisation. Relative and absolute configuration, sequence rule, D-L and R-S system of nomenclature.

Unit -II
Stereochemistry-II

Geometrical Isomerism: Concept of geometrical isomerism, E-Z system of nomenclature, geometrical isomerism in oximes and in cyclic compounds.

Conformational Isomerism: Conformational analysis of ethane and n-butane. Newman projection and sawhorse formulae, Fischer and Flying wedge formula. Difference between configuration and conformation.

Unit- III
Gaseous State

Gaseous laws, postulates of kinetic theory of gases and its derivation, deviation from ideal behavior (with respect to pressure and volume), Vander Waal's equation of gases, critical phenomenon, PV isotherm of real gases, continuity of state, isotherms of Vander Waal's equation, relationship between critical constant and Vander Waal's constant, the law of corresponding states, reduced equation of state.
Root mean square, average and most probable velocity. Qualitative discussion of the Maxwell`s distribution of molecular velocities. Collision number, mean free path and collision diameter. Liquefaction of gases.

Unit- IV
Liquid State & Solid State

Liquid State: Intermolecular forces, structure of liquids, Liquid crystals: Classification, structure and applications of liquid crystals.

Solid State: Definition of space lattice, unit cell. Laws of crystallography: law of constancy of interfacial angles , law of rationality of indices, law of symmetry. Symmetry elements in crystals. X ray diffraction by crystals, derivation of Bragg's equation. Determination of crystal structure of NaCl, KCl and CsCl, (Laue's method and powder method).

Learning Outcomes:

Students will be able to:

- learn about the states of matter viz. Solid, liquid and gases and applications of laws to define their properties.
- understand the basic concepts of stereochemistry and spatial arrangement of atoms and groups in a molecule and their nomenclature.

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Chemistry

Semester I

BCHE 151 **Chemistry Practical- I** **60 hrs (4 hrs/week)**

Inorganic Chemistry

Qualitative analysis: Separation and identification of three cations and three anions in the given inorganic mixture, specific tests for some typical combination of acid radicals (carbonate – sulphite, sulphite - sulphide – sulphate , sulphite - sulphide, nitrite – nitrate and chloride – bromide – iodide)

Physical Chemistry

Viscosity and Surface Tension

1. Determination of the relative viscosity of given unknown organic liquid by Ostwald viscometer
2. Determination of the percentage composition of a given mixture (non-interacting systems) by viscosity method
3. Determination of the relative surface tension of given unknown organic liquid by Stalagmometer.
4. Determination of the percentage composition of a given binary mixture by surface tension method.

Preparation of standard solutions (primary and secondary) and verify its strength.

(a) Preparation of N/10 HCl
(b) Preparation of N/10 NaOH.

Viva voce

Record

Learning Outcomes:

Students will be able to:

- learn about the identification of acidic (cation) and basic (anion) radicals in inorganic mixture experimentally.
- understand the concept of viscosity and surface tension and their determination.

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BACHELOR OF SCIENCE
Chemistry

Semester II

Semester Scheme

Paper Code	Paper title	Course Category	Credit	Total contact hours per semester / per week		Maximum marks	Minimum marks	ESE in hrs	
								Theory	Practical
BCHE 201	Inorganic and Organic Chemistry-II	DSC	2	30	2	50	20	3	-
BCHE 202	Organic and Physical Chemistry-II	DSC	2	30	2	50	20	3	-
BCHE 251	Chemistry Practical II	DSCP	2	60	4	50	20	-	4
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Chemistry

Semester II

Evaluation Scheme

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Max. hrs: 3 hrs. Max. Marks: 50

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	Total	**50 Marks**

Practical Paper

Max. hrs: 4 hrs. Max. Marks: 50

Experiment no. 1	Inorganic Chemistry	10 Marks
Experiment no. 2	Physical Chemistry	10 Marks
	Record	5 Marks
	Viva	5 Marks
	Total marks for End Semester Examination	**30 Marks**
	Internal Assessment	**20 Marks**
	Total	**50 Marks**

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BACHELOR OF SCIENCE
Chemistry

Semester II

Paper I

BCHE 201 **Inorganic and Organic Chemistry-II** **30 Hrs (2 hrs/week)**

Unit -I
Ionic Solids and Chemistry of p-Block Elements & some of its important Compounds

Ionic Solids: Radius ratio and coordination number, calculation of limiting radius ratio for tetrahedral, octahedral and cubic crystal structure, limitations of radius ratio rules, Polarizing power and polarisability of ions, Fajans rule, lattice energy and Born Haber Cycle and its applications, solvation energy and solubility of ionic solids.

Chemistry of p-Block Elements & some of its important compounds: Comparative study of p-block elements: group trends, electronic configuration, atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation, inert pair effect. Some important compounds of p- block elements (borazines, fullerenes, tetrasulphur tetranitride).

Unit-II
Metallic Bond and Chemistry of Noble Gases

Metallic Bond: Introduction of metallic bond, properties of metals, theories of metallic bond- Free Electron Theory, Valance Bond Theory, limitations of Valence Bond Theory, Molecular Orbital and Band theory, semiconductors, lattice defects in ionic solids.

Chemistry of Noble Gases: Chemical properties of noble gases, structures of xenon fluorides, oxyfluorides and oxides.

Unit-III
Alkenes and Cycloalkenes

Alkenes: Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydrations. The Saytzeff rule, Hofmann elimination. Physical properties and relative stabilities of alkenes. Chemical reactions of alkenes—mechanisms involved in hydrogenations, Markownikoffs rule, hydroboration–oxidation, oxymercuration-reduction, epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Subsititution at the allylic and vinylic position of alkenes.

Cycloalkenes : Method of formation, conformation and chemical reactions of cycloalkenes.

Unit-IV
Dienes and Alkynes

Dienes: Nomenclature and classification of dienes, isolated, conjugated and cumulated dienes, structure of allenes and butadiene, methods of formation, polymerization, chemical reactions, 1,2- and 1,4- additions, Diels-Alder reaction.

Alkynes: Nomenclature, structure and bonding in alkynes, methods of formation, chemical reactions of alkynes, acidity of alkynes, mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal – ammonia reduction, oxidation and polymerization.

Learning Outcomes:

Students will be able to:

- get deep insight about ionic & metallic solids and also periodicity of p- block elements.
- gain knowledge of preparation, properties of acyclic and cyclic unsaturated hydrocarbons.

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BACHELOR OF SCIENCE
Chemistry
Semester II

Paper II

BCHE 202 **Organic and Physical Chemistry-II** **30 Hrs (2 hrs/week)**

Unit -I
Aromaticity, Arene and Electrophilic Substitution Reactions

Aromaticity: The Huckel's rule, aromatic ions

Arenes: Nomenclature of benzene derivatives - aryl group, aromatic nucleus and side chain. Structure of benzene - molecular formula, Kekule structure, M.O. diagram. Stability and carbon-carbon bond length of benzene and its resonance structure.

Electrophilic Substitution reactions : General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel Craft's reaction with energy profile diagrams. Directive influence and reactivity of substituents, ortho/para ratio and Birch reduction.

Unit-II
Alkyl & Aryl Halides and Polyhalogenated Compounds

Alkyl & Aryl halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanism of nucleophilic substitution reaction, reactions of alkyl halides, S_N^1 and S_N^2 reactions with energy profile diagram.

Polyhalogenated Compounds : Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Synthesis and applications of DDT, BHC, chloroform and carbon tetra chloride.

Unit-III
Chemical Kinetics

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction. Mathematical characteristics of simple chemical reactions- zero, first, second and pseudo order reactions, half life and mean life. Determinations of the order of reaction- differential methods, methods of integration, methods of half-life period and isolation methods. Radioactive decay.
Experimental methods of chemical kinetics: conductometric, potentiometric, optical methods, polarimetry and spectrophotometric. Theories of chemical kinetics - Arrhenius concept of activation energy, simple collision theory based on hard sphere model and Transition State Theory.

Unit-IV
Colloidal State

Definition of colloids, classification of colloids, Solids in liquids (sols) properties- kinetic, optical and electrical. Stability of colloids, protective action, Hardy Schulze Law, Gold number.
Liquids in solids (gels): classification, preparation and properties, inhibition, general applications of colloid. Liquids in liquids (emulsions) - types of emulsions, preparation, Emulsifiers.

Learning Outcomes:

Students will be able to :

- understand the structure and properties of aromatic hydrocarbons and directive influence of various functional groups on arenes.
- interpret rate & mechanism of chemical reactions and also day to day applications of colloids.

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BACHELOR OF SCIENCE
Chemistry

Semester II

BCHE 251 **Chemistry Practical II** **60 hrs (4 hrs/week)**

Inorganic Chemistry

Quantitative Analysis: Volumetric Analysis

(a) Determination of acetic acid in commercial vinegar using NaOH.

(b) Determination of alkali content in antacid tablet using HCl.

(c) Estimation of calcium content in chalk as calcium oxalate by permanganometery.

(d) Estimation of ferrous and ferric ions by dichromate method.

(e) Estimation of copper using thiosulphate.

Organic Chemistry

1. Laboratory Techniques

(a) Determination of melting point of Naphthalene, Benzoic acid, Urea etc.

(b) Determination of boiling point of Ethanol , Methanol, Cyclohexane, etc

2. Qualitative analysis

Detection of elements (N, S and halogens) and functional group (phenolic, alcoholic, carboxylic, carbonyl, ester, amine, amide, nitro & carbohydrate) and hydrocaron in simple organic compounds.

Viva voce

Record

Learning Outcomes:

Students will be able to :

- determine the functional groups in organic compound through element detection.
- determine quantitative estimation of inorganic compounds by volumetric analysis.