# S.S. Jain Subodh P.G. College

**(Affiliated to University of Rajasthan)**

**SCHEME OF EXAMINATION**

**&**

**DETAILED COURSE STRUCTURE**

**(2023-24)**

**BACHELOR OF SCIENCE (B.Sc. CHEMISTRY)**

**DEPARTMENT OF CHEMISTRY**

Session 2023-24 Semester I & II
Session 2024-25 Semester III & IV
Session 2025-26 Semester V & VI

**S.S. Jain Subodh P.G. College, Jaipur**

**BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)**

**Nomenclature of Paper with Paper code**

**Session 2023-2024**

| **Semester I** | | |
|---|---|---|
| **S.No.** | **Nomenclature of Paper** | **Paper Code** |
| 1 | Inorganic and Organic Chemistry-I | SSCH101 |
| 2 | Organic and Physical Chemistry-I | SSCH102 |
| 3 | Analytical Chemistry-I | SSCH103 |
| 4 | Chemistry Practical -I | SSCH151 |
| **Semester II** | | |
| 5 | Inorganic and Organic Chemistry-II | SSCH201 |
| 6 | Organic and Physical Chemistry-II | SSCH202 |
| 7 | Analytical Chemistry- II | SSCH203 |
| 8 | Chemistry Practical- II | SSCH251 |
| **Semester III** | | |
| 9 | Inorganic and Organic Chemistry-III | SSCH301 |
| 10 | Organic and Physical Chemistry-III | SSCH302 |
| 11 | Analytical Chemistry- III | SSCH303 |
| 12 | Chemistry Practical-III | SSCH351 |
| **Semester IV** | | |
| 13 | Inorganic and Organic Chemistry-IV | SSCH401 |
| 14 | Organic and Physical Chemistry-IV | SSCH402 |
| 15 | Analytical Chemistry- IV | SSCH403 |
| 16 | Chemistry Practical- IV | SSCH451 |
| **Semester V** | | |
| 17 | Inorganic and Organic Chemistry-V | SSCH501 A |
| 18 | Organic and Physical Chemistry-V | SSCH502 A |
| 19 | Inorganic and Organic Chemistry-V | SSCH501 B |
| 20 | Organic and Physical Chemistry-V | SSCH502 B |
| 21 | Analytical chemistry-V | SSCH503 |
| 22 | Chemistry Practical- V | SSCH551 |
| **Semester VI** | | |
| 23 | Inorganic and Organic Chemistry-VI | SSCH601 A |
| 24 | Organic and Physical Chemistry-VI | SSCH602 A |
| 25 | Inorganic and Organic Chemistry-VI | SSCH601 B |
| 26 | Organic and Physical Chemistry-VI | SSCH602 B |
| 27 | Analytical Chemistry-VI | SSCH603 |
| 28 | Chemistry Practical-VI/ Field Project / Internship | SSCH651 |

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester I

### Semester Scheme

| Paper Code | Paper title | Course Category | Credit | Maximum marks | Minimum marks | ESE in hrs | |
|---|---|---|---|---|---|---|---|
| | | | | | | Theory | Practical |
| SSCH 101 | Inorganic and Organic Chemistry-I | DSC | 3 | 75 | 30 | 3 | - |
| SSCH 102 | Organic and Physical Chemistry-I | DSC | 3 | 75 | 30 | 3 | - |
| SSCH 103 | Analytical Chemistry-I | DSC | 3 | 75 | 30 | 3 | |
| SSCH 151 | Chemistry Practical -I | DSCP | 6 | 150 | 60 | - | 5 |
| | | | 15 | | | | |

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 5 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 75 which includes 54 marks for ESE and 21 marks for internal assessment. Maximum marks for a practical paper is 150 which includes 90 marks for ESE and 60 marks for internal assessment.**

**S.S. Jain Subodh P.G. College, Jaipur**

**BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)**

**Semester I**

**Evaluation Scheme**

**Theory Paper**

Max hrs: 3 hrs. Max. Marks: 75

Attempt all Questions

| | | |
|---|---|---|
| PART A | 7 Questions(very short answer questions) | 7x2= 14 marks |
| PART B | 4 Questions(1 question from each unitwith internal choice) | 4x10 = 40 marks |
| | **Total marks for End SemesterExamination** | **54 Marks** |
| | **Internal Assessment** | **21 Marks** |
| | **Maximum Marks** | **75 Marks** |
| | **Minimum Marks** | **30 Marks** |

**Practical Paper**

Max.Hrs: 5 hrs. Max. Marks: 150

| | | |
|---|---|---|
| Experiment no. 1 | Inorganic Chemistry | 20 marks |
| Experiment no. 2 | Organic Chemistry | 20 marks |
| Experiment no. 3 | Physical Chemistry | 20 marks |
| | Record | 15 marks |
| | Viva voce | 15 marks |
| | Total marks for End Semester Examination | 90 marks |
| | Internal Assessment | 60 marks |
| | **Total** | **150 marks** |

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester I

## Paper I

**SSCH 101 Inorganic and Organic Chemistry-I 45 Hrs (3 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.

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## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester I

## Paper I

**SSCH 101** **Inorganic and Organic Chemistry-I** **45 Hrs (3hrs/week)**

**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.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester I

## Paper II

**SSCH 102** **Organic and Physical Chemistry-I** **45 Hrs (3 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).

CONTD….

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester I

### Paper II

**SSCH 102** **Organic and Physical Chemistry-I** **45 Hrs (3 hrs/week)**

**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.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester I

## Paper III

**SSCH 103** **Analytical Chemistry- I** **45 Hrs (3 hrs/week)**

**UNIT I**
**Statistical Analysis**

Cleaning and calibration of glassware's. Statistical analysis of data : Significant figures, error in analysis, accuracy and precision, compilation and reliability of results, mean, median, mode, standard deviation, T, Q and F test and correction in analysis.

**UNIT II**
**Volumetric Analysis**

Basic principles of Volumetric Analysis, simple theoretical background of following types of titrations-
Iodometric & iodimetric titrations **:** Basic principle and titration of $CuSO_4$ using sodium thiosulphate and its applications.
Redox titrations **:** Standard potential, SHE, Electrochemical series, E.M.F calculations, Internal and external indicators. Basic principle and titration of FAS using $K_2Cr_2O_7$ solution and its applications.
Complexometric titrations: Types of EDTA titrations, masking and de- masking agents, metal ion indicator, applications in estimation of total hardness of water.
Precipitation titrations **:** Basic principle, applications in Volhard's Method.

**UNIT III**
**Gravimetric Analysis**

Principles of Gravimetric Analysis: precipitation methods, super saturation and precipitate formation, purity of precipitate, co-precipitation, post precipitation and conditions for precipitation, precipitation from homogenous solutions, masking and demasking agents.

**UNIT IV**
**Polarimetry**

Polarimetry **:** Basic principle of polarimetry, instrumentation, experimental techniques, determination of (a) specific rotation of a substance (b) concentration of substance & applications. An elementary idea of refractometry, interferometry- circular dichroism & optical rotatory dispersion.

**Learning Outcomes:**

**Students will be able to:**

- organize , manage and present data to get the most reliable results in scientific enquiry.
- determine the concentration of analyte by volumetric and gravimetric analysis & understand the concept of polarimetry.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester I

**SSCH 151** **Chemistry Practical –I** **90 hrs (6 hrs/week)**

**Note: Total marks for each semester practical is 150, which include 90 marks for ESE and 60 marks for internal assessment.**

**Duration: 5 hours** **Max. Marks: 90**

| | | |
|---|---|---|
| Experiment no. 1 | Inorganic Chemistry | 20 marks |
| Experiment no. 2 | Organic Chemistry | 20 marks |
| Experiment no. 3 | Physical Chemistry | 20 marks |
| Record | | 15 marks |
| Viva- Voce | | 15 marks |

**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)

**Organic Chemistry**

Determination of melting point and crystallization.

Identification of functional groups in organic compounds: unsaturation, alcoholic, phenolic, aldehydic, ketonic, carboxylic, ester, nitro, amido, amino, sulphonic acids, carbohydrates, halogen derivatives and hydrocarbon..

**Physical Chemistry**

1. Viscosity and Surface Tension

(i) Determination of the relative viscosity of given unknown organic liquid by Ostwald viscometer
(ii) Determination of the percentage composition of a given mixture (non-interacting systems) by viscosity method
(iii) Determination of the relative surface tension of given unknown organic liquid by Stalagmometer.
(iv) Determination of the percentage composition of a given binary mixture by surface tension method.

CONTD….

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester I

**BCHE(H) 151** **Chemistry Practical –I** **90 hrs (6hrs/week)**

2. Preparation of standard solutions (primary and secondary) and verify its strength.
   (i) Preparation of N/10 HCl
   (ii) Preparation of N/10 NaOH.

**Viva voce**

**Record**

**Learning Outcomes:**

**Students will be able to:**

- identify acidic (cation) and basic (anion) radicals in inorganic mixture and functional group in organic compounds.
- prepare standard solutions and understand the concept of viscosity and surface tension and their determination.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester II

## Semester Scheme

| Paper Code | Paper title | Course Category | Credit | Maximum marks | Minimum marks | ESE in hrs | |
|---|---|---|---|---|---|---|---|
| | | | | | | Theory | Practical |
| SSCH201 | Inorganic and Organic Chemistry-II | DSC | 3 | 75 | 30 | 3 | - |
| SSCH202 | Organic and Physical Chemistry-II | DSC | 3 | 75 | 30 | 3 | - |
| SSCH203 | Analytical Chemistry- II | DSC | 3 | 75 | 30 | 3 | |
| SSCH251 | Chemistry Practical- II | DSCP | 6 | 150 | 60 | - | 5 |
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**S.S. Jain Subodh P.G. College, Jaipur**

**BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)**

**Semester II**

**Evaluation Scheme**

**Theory Paper**

Max hrs: 3 hrs. Max. Marks: 75

Attempt all Questions

| | | |
|---|---|---|
| PART A | 7 Questions(very short answer questions) | 7x2= 14 marks |
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| | **Internal Assessment** | **21 Marks** |
| | **Maximum Marks** | **75 Marks** |
| | **Minimum Marks** | **30 Marks** |

**Practical Paper**

Max.Hrs:5 hrs. Max. Marks: 150

| | | |
|---|---|---|
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| Experiment no. 2 | Organic Chemistry | 20 marks |
| Experiment no. 3 | Physical Chemistry | 20 marks |
| | Record | 15 marks |
| | Viva voce | 15 marks |
| | Total marks for End Semester Examination | 90 marks |
| | Internal Assessment | 60 marks |
| | **Total** | **150 marks** |

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester II

## Paper I

**SSCH 201 Inorganic and Organic Chemistry-II 45 Hrs (3 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.

Cycloalkene**s :** Methods of formation, conformation and chemical reactions of cycloalkenes.

**Unit-IV**
**Dienes and Alkynes**

Diene**s:** 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.

Alkyne**s:** 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.

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## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester II

## Paper I

**SSCH 201** **Inorganic and Organic Chemistry-II** **45 Hrs (3 hrs/week)**

**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.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester II

## Paper II

**SSCH 202** **Organic and Physical Chemistry-II** **45 Hrs (3 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.

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## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester II

## Paper II

**SSCH 202** **Organic and Physical Chemistry-II** **45 Hrs (3 hrs/week)**

**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.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester II

## Paper III

**SSCH 203** **Analytical Chemistry-II** **45 Hrs (3 hrs/week)**

**UNIT I**
**Purification and Analysis of organic compounds**

Distillation methods of organic solvents: steam, fractional, vacuum and molecular distillations, manometers and manostates. Analysis of oils and fats, Saponification Value, Iodine Value, RM value, Acid Value. Quantitative estimation of following functional groups- alcoholic, phenolic, carboxylic acids and unsaturated groups (olefinic & acetylenic).

**UNIT II**
**Solvent Extraction**

Principles and process of solvent extraction. Distribution law & Partition Coefficient, liquid- liquid extraction, factors favoring solvent extraction, choice of solvent for solvent extraction, stripping. Solid liquid extraction, organic reagents used in solvent extraction

**UNIT III**
**Analysis of Water pollutants**

Water pollutants, analysis of water for dissolved oxygen, BOD and COD, biological treatment methods, preventation of water pollution by treatment of industrial wastes with special reference to cement industries, fertilizer industries and dying industries.

**UNIT IV**
**Air pollution**

General considerations, types of air pollutants, units of measurement, sampling, monitoring and analysis of CO and $SO_2$ in atmosphere, effect of air pollutants on plants and human health, methods for pollution control – specially for pollution by automobiles.

**Learning Outcomes:**

**Students will be able to :**

- purify and determine the contents of various inorganic and organic species by distillation methods and understand the concepts of solvent extraction.
- monitor and provide solutions to the air and water pollutants affecting the environment.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester II

**SSCH 251** **Chemistry Practical - II** **90 hrs (6hrs/week)**

**Note: Total marks for each semester practical is 150, which includes 90 marks for ESE and 60 marksfor internal assessment.**

**Duration: 5 hours** **Max. Marks: 90**

| | | |
|---|---|---|
| Experiment no. 1 | Inorganic Chemistry | 20 marks |
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| Experiment no. 3 | Physical Chemistry | 20 marks |
| Record | | 15 marks |
| Viva voce | | 15 marks |

**Inorganic Chemistry**

Quantitative Analysis: Volumetric Analysis ( Any three)

(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: Identification of organic compounds through the functional group analysis, determination of melting point/boiling point and preparation of suitable derivatives.

**Physical Chemistry**

(a) Study of the solubility curve of phenol in water and hence study the effect of separate addition of substances such as naphthalene, potassium chloride and acetic acid.
(b) Determine the pH of different buffer solutions and evaluate the $pk_a$ value of an acid by Handerson equation.
(c) Determine the molecular complexity of benzoic acid in benzene by distribution law

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## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester II

| | | |
|---|---|---|
| **SSCH 251** | **Chemistry Practical - II (6hrs/week)** | **90 hrs** |

**Viva voce**

**Record**

**Learning Outcomes:**

**Students will be able to :**

- determine the functional groups in organic compound through element detection and quantitative estimation of inorganic compounds by volumetric analysis.
- learn the laboratory techniques and understand the solubilty curve, pH, molecular complexity and heat of reaction.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester III

### Semester Scheme

| Paper Code | Paper title | Course Category | Credit | Maximum marks | Minimum marks | ESE in hrs | |
|---|---|---|---|---|---|---|---|
| | | | | | | Theory | Practical |
| **SSCH** 301 | Inorganic and Organic Chemistry-III | DSC | 3 | 75 | 30 | 3 | - |
| **SSCH** 302 | Organic and Physical Chemistry-III | DSC | 3 | 75 | 30 | 3 | - |
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| **SSCH** 351 | Chemistry Practical-III | DSCP | 6 | 150 | 60 | - | 5 |
| | | | 15 | | | | |

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|---|---|---|---|---|
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**Each theory paper is of 3 hours duration. Each Practical /Lab work is of 5 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 75 which includes 54 marks for ESE and 21 marks for internal assessment. Maximum marks for a practical paper is 150 which includes 90 marks for ESE and 60 marks for internal assessment.**

**S.S. Jain Subodh P.G. College, Jaipur**

**BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)**

**Semester III**

**Evaluation Scheme**

**Theory Paper**

**Max hrs: 3hrs.** **Max. Marks 75**

Attempt all Questions

| | | |
|---|---|---|
| PART A | 7 Questions(very short answerquestions) | 7x2= 14marks |
| PART B | 4 Questions( 1 question from each unit with internal choice) | 4x10 = 40 marks |
| | **Total marks for End SemesterExamination** | **54 Marks** |
| | **Internal Assessment** | **21 Marks** |
| | **Maximum Marks** | **75 Marks** |
| | **Minimum Marks** | **30 Marks** |

**Practical Paper**

**Max.Hrs:5 hrs.** **Max. Marks: 150**

| | | |
|---|---|---|
| Experiment no. 1 | Inorganic Chemistry | 20 marks |
| Experiment no. 2 | Organic Chemistry | 20 marks |
| Experiment no. 3 | Analytical Chemistry | 20 marks |
| | Record | 15 marks |
| | Viva voce | 15 marks |
| | Total marks for End Semester Examination | 90 marks |
| | Internal Assessment | 60 marks |
| | **Total** | **150 marks** |

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester III

## Paper I

**SSCH 301** **Inorganic and Organic Chemistry- III** **45 Hrs (3hrs/Week)**

**Unit -I**
**Acids, Bases and HSAB**

Acids and Bases**:** Brønsted - Lowry (the proton donor acceptor system), proton affinity, Lewis concept of acids and bases (the electron donor acceptor concept), the Lux-Flood (oxide ion concept), solvent system concept and their limitations.

Hard and Soft Acids and Bases (HSAB): Hard & Soft Acids and Bases and their Classification, Pearson's HSAB concept, Symbiosis, Theoretical basis of hardness and softness, limitations and applications of HSAB.

**Unit-II**
**Non-aqueous Solvents and Chromatography**

Non-Aqueous Solvents**:** Physical properties of solvent, types of solvent and their general characteristics, reactions in non-aqueous solvents with reference to liq. $NH_3$.

Chromatography**:** Types of chromatographic methods (Paper, Thin Layer and Column Chromatography) and their applications, principle of differential migration, adsorption phenomenon, nature of the adsorbent, solvent systems, $R_f$ values.

**Unit-III**
**Chemistry of Functional group-I (Alcohols)**

Alcohols**:** Classification and Nomenclature. Monohydric Alcohols**:** Methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding, acidic nature, reaction of alcohols. Dihydric Alcohols: Methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and $HIO_4$] and Pinacol- Pinacolone rearrangement. Trihydric Alcohols- Methods of formation and chemical reactions of glycerol.

**Unit-IV**
**Chemistry of Functional group-II (Phenols)**

Phenols: Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion, reaction of phenols, electrophilic aromatic substitions, acylations and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gattermann synthesis, Houben- Hoesch reaction, Lederer- Manasse reaction and Reimer -Tiemann reaction

CONTD…

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Paper I

**SSCH 301** **Inorganic and Organic Chemistry- III** **45 Hrs (3hrs/Week)**

**Learning Outcomes:**

Students will be able to:

- learn the concept and theories of acids and bases and get acquainted with the principle & applications of chromatographic techniques.
- augment knowledge of alkyl and aryl hydroxy derivatives with their preparation and properties.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester III

## Paper II

**SSCH 302** **Organic and Physical Chemistry-III** **45 Hrs (3 hrs/week)**

**Unit -I**
**Chemistry of Functional group-III (Aldehyde and Ketone)**

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1, 3 dithianes, synthesis of ketones from nitriles and from carboxylic acids, physical properties, mechanism of nucleophilic addition to carbonyl group: Benzoin, Aldol, Perkin and Knovenagel condensations, Wittig reaction, Mannich reaction, Cannizzaro reaction, Bayer- Villiger, Meerwein–Ponndorf–Verley reduction (MPV), Clemmensen's reduction, Wolf- Kishner reduction, $LiAlH_4$ and $NaBH_4$ reduction, condensation with ammonia and its derivatives, use of acetals as protecting group, oxidation of aldehydes and ketones.

**Unit-II**
**Chemistry of Functional group-IV (Ether and Epoxide)**

Nomenclature of ethers and methods of their formation, physical properties, chemical reactions- cleavage and auto- oxidation, Ziesel's method. Synthesis of epoxides, Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening. Reactions of Grignard and organolithium reagents with epoxides.

**Unit-III**
**Thermodynamics-I and Themochemistry**

Thermodynamics-I : Definition of thermodynamic terms: systems, surroundings etc. Types of systems, intensive and extensive properties, State & path functions and their differentials. Thermodynamic process, concept of heat and work. First law of thermodynamics - statement, definition of internal energy and enthalpy, heat capacity. Heat capacities at constant volume and constant pressure and their relationship. Joule's law, Joule Thomson co-efficient and inversion temperature.

Thermochemistry**:** Standard state, standard enthalpy of formation- Hess`s Law of heat summations and its applications, heat of reactions at constant pressure and constant volume. Enthalpy of neutralization, Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

**Unit -IV**
**Chemical Equilibrium and Corrosion**

Equilibrium constant and free energy, Thermodynamic derivation of law of mass action, Le-Chatelier`s principle. Reaction isotherm and reaction isochore, Clausius- Clapeyron equation and its applications.
pH : Definition of pH and pKa, determination of pH using hydrogen, quinhydrone and glass electrodes and by poteniometric methods. Buffers - mechanism of buffer action. Henderson- Hazel equation. Hydrolysis of salts.

Corrosion: Fundamentals of electrolytic corrosion- theories and kinetics, corrosion prevention. Batteries – primary( Zinc- carbon, Zinc- air) and secondary ( Litthium ion and Lead Acid) and fuel cells ( Hydrogen fuel cell).

CONTD….

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester III

## Paper II

**SSCH 302** **Organic and Physical Chemistry-III** **45 Hrs (3 hrs/week)**

**Learning Outcomes:**

**Students will be able to:**

- conversant with synthesis, physical and chemical properties of aldehydes, ketones, ethers and epoxides.
- interpret definitions of different thermodynamic processes and assess thermodynamic applications using First law of thermodynamics.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester III

### Paper III

**SSCH 303** **Analytical Chemistry-III** **45 Hrs (3hrs/Week)**

**UNIT I**
**Chromatography**

Principles of adsorption and partition chromatography, techniques and applications of column, paper and thin layer chromatography. Electrophoresis and its applications in separation of amino acids.

**UNIT II**
**Ion Exchange Methods**

General discussion of ion exchange methods, types of ion exchange resins, action of ion exchange resins, column operation and experimental techniques, determination of the following pairs by ion exchange techniques; (a) chlorides and bromides (b) nickel and cobalt.

**UNIT III**
**Conductometric and High Frequency Titrations**

Conductometric titrations: basic theory, apparatus and measurement, types of conductometric titrations, applications of conductometric titrations.

High frequency titrations: basic theory, instrumentation, advantages and some applications of the high frequency titrations

**UNIT IV**
**Potentiometric Titrations**

Introduction, electrodes, instrumentation. Potentiometric titrations, differential potentiometric titrations, automatic potentiometric titrations, location of end points, determination of some metals through potentiometric titrations .Applications of potentiometric titrations in (i) Estimation of Calcium using EDTA
(ii) Estimation of Fe (III) with Ce (III).

**Learning Outcomes:**

**Students will be able to :**

- learn the theoretical and practical concepts of chromatography and ion exchange techniques.
- do volumetric estimation of solutions via potentiometric, conductometric and high frequency titrations.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester III

**SSCH 351** **Chemistry Practical-III** **90 hrs (6 hrs/week)**

**Note: Total marks for each semester practical is 150, which includes 90 marks for ESE and 60 marks for internal assessment.**

**Duration 5 hours** **Max. Marks: 90**

| | | |
|---|---|---|
| Experiment no. 1 | Inorganic Chemistry | 20 marks |
| Experiment no .2 | Organic Chemistry | 20 marks |
| Experiment no. 3 | Analytical Chemistry | 20 marks |
| Record | | 15 marks |
| Viva voce | | 15 marks |

**Inorganic Chemistry**

1. Quantitative (Gravimetric):( any three)

(a) Estimation of Barium (as sulphate)
(b) Estimation of Lead (as chromate)
(c) Estimation of Copper (as cuprous thiocyanate)
(d) Estimation of Nickel (as dimethyl glyoximate)
(e) Estimation of Silver (as chloride)
(f) Estimation of Zinc (as ammonium phosphate)
(g) Estimation of Magnesium (as hydrogen phosphate)

2. Volumetric Analysis: (Any One)

(a) Redox titration of ferrous ammonium sulphate against $KMnO_4$
(b) Determination of hardness of water by EDTA solution.
(c) Iodometric Titrations: determination of strength of $CuSO_4$ solution using hypo solution.

**Organic Chemistry**

Quantitative Analysis

(a) Determination of neutralization equivalent of an acid.
(b) Estimation of glucose by titration with Fehling's solution/ Bendict's solution.
(c) Estimation of glycine by formaldehyde method.

CONTD….

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester III

**SSCH 351** **Chemistry Practical-III** **90 hrs (6 hrs/week)**

**Analytical Chemistry**

Using TLC/ Paper chromatography Techniques: (Any two)

(a) Determination of $R_f$ value and identification of organic compounds.
(b) Separation of Spinach extract in to some of its individual pigments.
(c) Separation of the given mixture of amino acids.

**Viva-Voce**

**Record**

**Learning Outcomes:**

**Students will be able to :**

- execute the quantitative estimation of inorganic compounds through gravimetric and volumetric methods and qualitatively identify the organic compounds.
- determine the total hardness of water, Rf values and chromatographic separation of components of solutions.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester IV

### Semester Scheme

| Paper Code | Paper title | Course Category | Credit | Maximum marks | Minimum marks | ESE in hrs | |
|---|---|---|---|---|---|---|---|
| | | | | | | Theory | Practical |
| **SSCH** 401 | Inorganic and Organic Chemistry-IV | DSC | 3 | 75 | 30 | 3 | - |
| **SSCH** 402 | Organic and Physical Chemistry-IV | DSC | 3 | 75 | 30 | 3 | - |
| **SSCH** 403 | Analytical Chemistry- IV | DSC | 3 | 75 | 30 | 3 | |
| **SSCH** 451 | Chemistry Practical- IV | DSCP | 6 | 150 | 60 | - | 5 |
| | | | 15 | | | | |

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 5 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 75 which includes 54 marks for ESE and 21 marks for internal assessment. Maximum marks for a practical paper is 150 which includes 90 marks for ESE and 60 marks for internal assessment**

**S.S. Jain Subodh P.G. College, Jaipur**

**BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)**

**Semester IV**

**Evaluation Scheme**

**Theory Paper**

Max hrs: 3 hrs. Max. Marks: 75

Attempt all Questions

| | | |
|---|---|---|
| PART A | 7 Questions(very short answer questions) | 7x2= 14marks |
| PART B | 4 Questions( 1 question from each unit with internal choice) | 4x10 = 40 marks |
| | **Total marks for End Semester Examination** | **54 Marks** |
| | **Internal Assessment** | **21 Marks** |
| | **Maximum Marks** | **75 Marks** |
| | **Minimum Marks** | **30 Marks** |

**Practical Paper**

**Max.Hrs: 5hrs.** Max. Marks: 150

| | | |
|---|---|---|
| Experiment no. 1 | Inorganic Chemistry | 20 marks |
| Experiment no. 2 | Organic Chemistry | 20 marks |
| Experiment no. 3 | Physical Chemistry | 20 marks |
| | Record | 15 marks |
| | Viva voce | 15 marks |
| | Total marks for End Semester Examination | 90 marks |
| | Internal Assessment | 60 marks |
| | **Total** | **150 marks** |

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester IV

## Paper I

**SSCH 401** **Inorganic and Organic Chemistry-IV** **45 Hrs (3 hrs/week)**

**Unit -I**
**Inorganic Polymers and Bioinorganic Chemistry**

Inorganic Polymers **:** Silicones- Classification, preparation and structure of silicones, silicone resin, silicone rubber, silicone fluid, industrial application of silicones. Phosphazenes- Structure and bonding, preparation, properties (substitution reaction) and applications.

Bioinorganic Chemistry: Metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with reference to $Na^{+}$, $K^{+}$, $Ca^{+2}$ and $Mg^{+2}$.

**Unit-II**
**Oxidation and Reduction**

Oxidation and Reduction**:** Use of redox potential data, analysis of redox cycle, redox stability in water, disproportionation, the diagrammatic representation of redox potential data- Frost, Latimer and Pourbaix diagrams.

**Unit-III**
**Chemistry of Functional group-V (Carboxylic acids)**

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength, preparation of carboxylic acids, reactions of carboxylic acids– Hell-Volhard- Zelinisky reaction, reduction of carboxylic acids, mechanism of decarboxylation. Hydroxy acids- malic, tartaric and citric acids. Dicarboxylic acids- effect of heat and dehydrating agents (Succinic, Glutaric and Adipic acid).

**Unit-IV**
**Chemistry of Functional group-VI (Carboxylic acids derivatives)**

Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides, relative stability of acyl derivatives, Preparation of carboxylic acid derivatives, Physical properties, inter conversion of acid derivatives by nucleophilic acyl substitution, chemical reactions, mechanism of esterification and hydrolysis ( acidic and basic ).

**Learning Outcomes:**

**Students will be able to :**

- demonstrate structure and functioning of metalloporphyrin and applications of redox potential data in stability of metal compounds.
- describe physical and chemical properties of aliphatic carboxylic acids along with relative stability and interconversion of acid derivatives.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester IV

## Paper II

**SSCH 402** **Organic and Physical Chemistry-IV** **45 Hrs (3 hrs/week)**

**Unit -I**
**Spectroscopy-I (UV and IR)**

Ultraviolet (UV) Absorption spectroscopy: absorption laws (Beer- Lambert Law) molar absorptivity, types of electronic transitions, effect of solvents on transitions, effect of conjugation, concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts.

Infrared (IR) Absorption Spectroscopy**:** Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, finger print region, characteristic absorptions of various functional groups and interpretation of IR spectra of Alcohols, Carbonyl compounds, Carboxylic acids, Amines, Amides and Phenols.

**Unit-II**
**Chemistry of Functional group-VII (Amines)**

Amines**:** Amonium salts as phase transfer catalysts, preparation of alkyl and aryl amines (reduction of nitro compounds and nitriles), Gabriel-Phthalamide reaction, Hofmann-Bromamide reactions. Reactions of amines-electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acids, Diazotization-mechanism, synthetic transformation of aryl diazonium salts, azo coupling.

**Unit-III**
**Thermodynamics-II**

Second Law of Thermodynamics: Need for the law, different statements of the law, Carnot cycle, Carnot Theorem and its efficiency, Thermodynamic scale of temperature. Entropy as a state function, entropy as a function of volume and temperature, entropy as a function of pressure and temperature. Clausius inequality, entropy as a criteria of spontaneity and equilibrium, Entropy change in ideal gases and mixing of gases.
Third Law of Thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities. Variation of G and A with P, V and T.

**Unit -IV**
**Electrochemistry-I**

Conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution, Migration of ions and Kohlrausch's law, Arrhenius theory of electrolytes, Ostwald's dilution law- its uses and limitations. Debye- Huckel -Onsager`s equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf's method and Moving Boundary method. Application of conductivity measurements; determination of degree of dissociation, $K_a$ of acids, solubility product of a sparingly soluble salts and conductometric titrations.

CONTD….

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester IV

## Paper II

**SSCH 402** **Organic and Physical Chemistry-IV** **45 Hrs (3 hrs/week)**

**Learning Outcomes:**

**Students will be able to :**

- interpret the structure of organic compounds through spectroscopic technique viz. UV and IR
- analyse feasibility of chemical reactions, efficiency of machine and understand fundamentals of electrochemistry.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester IV

## Paper III

**SSCH 403** **Analytical Chemistry-IV** **45 Hrs (3 hrs/week)**

**UNIT I**
**Spectrophotometry**

Basic principle, instrumentation, experimental techniques, spectrophotometric analysis of Fe(III), Cu (II)with EDTA, Fe(III) in presence of Al(III) with EDTA and analysis of As(III) and Sb(III) in a mixture.

**Nephelometry and Turbidimetry**
Basic principle, instrumentation and applications in determination of (a) sulphate (b) phosphate

**UNIT II**
**Flame emission and Atomic Absorption Spectroscopy**

Flame Spectrometric technique: basic principle, instrumentation, flames and flame temperature, interferences nebulization and applications.
Atomic Absorption spectroscopy: basic principle of A.A.S, instrumentation, interference in A.A.S, determination of Ca and Mg in tap water and traces of Lead in ferrous alloys by A.A.S.

**UNIT III**
**Atomic Emission Spectroscopy**

Principle, instrumentation and spectroscopic sources of A.E.S., qualitative and quantitative analysis by A.E.S. qualitative spectroscopic analysis of a non ferrous alloy and complex organic mixture. Introduction, principle and instrumentation of plasma emission spectroscopy and sources of plasma

**UNIT IV**
**Thermal Methods of Analysis**

Thermogravimetric Analysis (TGA): Instrumentation and applications. Differential Thermal Analysis (DTA): Instrumentation and applications. Differential Scanning Calorimetry (DSC), instrumentation and applications.

**Learning Outcomes:**

**Students will be able to:**

- interpret elemental analysis technique of spectroscopy and know the significance of thermal analytical techniques.
- select appropriate methods for sample treatment in A.A.S. / A.E.S.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester IV

**SSCH 451** **Chemistry Practical -IV** **90 hrs (6 hrs/week)**

**Note: Total marks for each semester practical is 150, which includes 90 marks for ESE and 60 marks for internal assessment.**

**Duration 5 hours** **Max. Marks: 90**

| | | |
|---|---|---|
| Experiment no. 1 | Inorganic Chemistry | 20 marks |
| Experiment no. 2 | Organic Chemistry | 20 marks |
| Experiment no. 3 | Physical Chemistry | 20 marks |
| Record | | 15 marks |
| Viva voce | | 15 marks |

**Inorganic Chemistry**

Preparation (Any four)

(a) Preparation of Sodium trioxalatoferrate(III) .
(b) Preparation of $[Ni(DMG)_2]$complex.
(c) Preparation of Tetraamminecopper(II) sulphate complex .
(d) Preparation of cis- and trans- diaquabisoxalatochromate(III) ion.
(e) Preparation of Sodium tetrathionate.

**Organic Chemistry**

Synthesis of Organic Compounds: ( Any four )

(a) Acetylation : Salicylic acid, aniline, glucose and hydroquinone
(b) Aliphatic Electrophilic Substitution : Preparation of iodoform from ethanol and acetone
(c) Aromatic Electrophilic Substitution :
Nitration- Preparation of m-dinitrobenzene, Preparation of p-nitroacetanilide,
Halogenations- Preparation of p-bromoacetanilide and Preparation of 2,4,6-tribromophenol
(d) Diazotization/Coupling: Preparation of methyl orange and methyl red
(e) Oxidation : Preparation of benzoic acid from toluene
(f) Reduction : Preparation of aniline from nitrobenzene, Preparation of m-nitroaniline from m-dinitrobenzene

CONTD….

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester IV

**SSCH 451** **Chemistry Practical -IV** **90 hrs (6hrs/week)**

**Physical Chemistry**

Thermochemistry **:**

(a) Determine the solubility of benzoic acid at different temperature and determine $H^+$ of the dissolution process.
(b) Determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionization of the weak acid /weak base.
(c) Determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born -Haber cycle.

**Viva-Voce**

**Record**

**Learning Outcomes:**

**Students will be able to :**

- learn experimentally the synthesis of various organic compounds in laboratory using different types of organic reactions.
- demonstrate the understanding the concepts of thermochemistry in determining enthalpy of neutralization, ionoization and solution.

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester V

### Semester Scheme

| Group | Paper Code | Paper title | Course Category | Credit | Maximum marks | Minimum marks | ESE in hrs | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory | Practical |
| Group A* | **SSCH** 501 A | Inorganic and Organic Chemistry-V | DSE | 3 | 75 | 30 | 3 | - |
| | **SSCH** 502 A | Organic and Physical Chemistry-V | DSE | | | | | |
| Group B* | **SSCH** 501 B | Inorganic and Organic Chemistry-V | DSE | 3 | 75 | 30 | 3 | - |
| | **SSCH** 502 B | Organic and Physical Chemistry-V | DSE | | | | | |
| | **SSCH** 503 | Analytical chemistry-V | DSE | 3 | 75 | 30 | 3 | |
| | **SSCH** 551 | Chemistry Practical- V | DSEP | 6 | 150 | 60 | - | 5 |
| | | | | 15 | | | | |

The details of the courses with code and title assigned are given below:
DSE= Discipline Specific Elective
ESE = End Semester Examination
DSEP= Discipline Specific Elective Practical

**Note: Student has to choose any one elective paper from Group A* (501 A or 502 A) and Group B* (501 B or 502 B).**

**SSCH 503 and SSCH 551 is mandatory.**

## S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester V

### Semester Scheme

### 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 5 hours duration.**

The number of papers and the maximum marks for each paper/ practical is shown in the syllabus for thepaper 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 75 which includes 54 marks for ESE and 21 marks for internal assessment. Maximum marks for a practical paper is 150 which includes 90 marks for ESE and 60 marks for internal assessment.**

**S.S. Jain Subodh P.G. College, Jaipur**

**BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)**

**Semester V**

**Evaluation Scheme**

## Theory Paper

Max hrs: 3 hrs. Max. Marks: 75

Attempt all Questions

| | | |
|---|---|---|
| PART A | 7 Questions (very short answer questions) | 7x2= 14marks |
| PART B | 4 Questions (1 question from each unit with internal choice) | 4x10 = 40 marks |
| | **Total marks for End SemesterExamination** | **54 Marks** |
| | **Internal Assessment** | **21 Marks** |
| | **Maximum Marks** | **75 Marks** |
| | **Minimum Marks** | **30 Marks** |

## Practical Paper

**Max.Hrs: 5 hrs.** Max. Marks: 150

| | | |
|---|---|---|
| Experiment no. 1 | Inorganic Chemistry | 20 marks |
| Experiment no. 2 | Organic Chemistry | 20 marks |
| Experiment no. 3 | Physical Chemistry | 20 marks |
| | Record | 15 marks |
| | Viva voce | 15 marks |
| | Total marks for End Semester Examination | 90 marks |
| | Internal Assessment | 60 marks |
| | **Total** | **150 marks** |

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester V

**Group A** **Paper I**

**SSCH 501 A** **Inorganic and Organic Chemistry-V** **45 Hrs (3 hrs/week)**

**Unit -I**
**Coordination Compounds**

Werner's coordination theory and its experimental verification, Effective Atomic Number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, Valence Bond Theory of transition metal complexes with reference to tetrahedral, octahedral and square planar complexes, Back bonding, limitations of Valence Bond Theory.

**Unit-II**
**Chemistry of Elements of First Transition Series & Spectral Properties of Transition Metal Complexes**

Chemistry of Elements of First Transition Series**:** Properties of the elements of the first transition series, complexes illustrating relative stability of their oxidation states, types of magnetic behaviour, magnetic and molar susceptibility, determination of magnetic susceptibility.

Spectral properties of transition metal complexes**:** Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states and specrtoscopic terms (L-S Coupling), spectrochemical series, Orgel- energy level diagram for $d^1$ and $d^9$ states, electronic spectrum of $[Ti(H_2O)_6]^{+3}$ complex ion.

**Unit-III**
**Spectroscopy (NMR)**

Proton Magnetic Resonance $^1$H-NMR spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constant, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, ethyl acetate and 1,1,2- tri bromo ethane. Problems pertaining to the structural elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

**Unit-IV**
**Organometallic Compounds**

The Grignard reagent- preparation, structure and chemical reactions, Organozinc compounds- preparation and chemical reactions, Organolithium compounds- preparation and chemical reactions.

**Learning Outcomes:**

**Students will be able to :**

- understand geometries of complex compounds and explain stability, magnetic properties and colour of transition compounds.
- interpret spectra of basic organic compounds and can design synthetic routes for drugs.

**Semester V**

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Paper II

**SSCH 502 A** **Organic and Physical Chemistry-V** **45 Hrs (3 hrs/week)**

**Unit-I**
**Bio Molecules: Introduction to Nucleic acid and Vitamins**

Nucleic acids**:** Introduction, constituents of nucleic acids - ribo and deoxy ribonucleosides, nucleotides and structure of DNA and RNA.

Vitamins**:** Introduction, Biological importance and diseases caused by the deficiency of Vitamin A, B, C, D, E and K. Structural elucidation of Vitamin C and E.

**Unit-II**
**Synthetic dyes**

Colour and constitution (electronic concept), Classification of dyes. Chemistry and synthesis of methyl orange, congo red, malachite green, crystal violet, phenolphthalein, fluorescein, alizarin and indigo.

**Unit-III**
**Quantum Mechanics**

Black-body radiation, Planck`s radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects. de Broglie hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation. Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box. Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance. Molecular orbital theory- Basic idea, criteria for forming M.O.'s. from A.O.'s. Construction of M.O's by LCAO method ($H^+$ ion). Hybrid orbitals sp, $sp^2$, and $sp^3$. Calculation of coefficients of atomic orbitals used in these hybrid orbitals.

**Unit -IV**
**Adsorption and Photochemistry**

Adsorption: Difference between adsorption, absorption and sorption, chemisorption, adsorbent and adsorbate, reversible and irreversible adsorption, characteristics of adsorption, adsorption of gases by solids, factors affecting adsorption, types of adsorptions, types of adsorption isotherms- Freundlich and Langmuir adsorption isotherms.

Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus-Drapper law, Stark-Einstien law, Jablonski diagram depicting various processes occurring in the excited state., qualitative description of fluorescence, phosphorescence, non radiative process ( internal conversion, inter system crossing ) quantum yield, photosensitized reaction-energy transfer process (simple examples)

**Learning Outcomes:**

**Students will be able to :**

- demonstrate about differentiating nucleic acids and gain knowledge of structure of dyes and their colour.
- describe dual behavior of matter and quantitative approach of hybridization.

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester V

## Paper I

**SSCH 501 B** **Inorganic and Organic Chemistry-V** **45 Hrs (3hrs/week)**

**Unit-I**
**Solvent Extraction**

Principles and process of solvent extraction, distribution law and partition coefficient, batch extraction, continuous extraction and counter current distribution.

**Unit-II**
**Qualitative and Quantitative Inorganic Analysis**

Common ion effect, solubility product and their applications in qualitative analysis, chemistry of analysis of various groups of basic and acidic radicals, Theory of oxidation reduction (Redox) titration, redox indicators, complexometric titrations with the reference to EDTA, complexometric indicators.

**Unit-III**
**Molecular Rearrangements**

General mechanism of following molecular rearrangements- Benzil-Benzilic acid, Pinacol- Pinacolone, Bayer-Villiger, Favorskii, Schmidt, Wolf and Claisen - Cope rearrangements.

**Unit-IV**
**Fats, Oils and Detergents**

Natural fats, edible and industrial oils of vegetable resins, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, Iodine Value, Acid Value, soaps, synthetic detergents, alkyl and aryl sulphonates.

**Learning Outcomes:**
**Students will be able to :**

- develop skills required for qualitative and quantitative inorganic analysis and separation processes.
- understand fundamental aspects of fats, oils & detergents and rearrangement reactions.

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester V

## Paper II

**SSCH 502 B** **Organic and Physical Chemistry-V** **45 Hrs (3 hrs/week)**

**Unit -I**
**Carbohydrates**

Classification and nomenclature, monosaccharides, mechanism of osazone formation, inter conversion of glucose and fructose, chain lengthing and chain shortening of aldose. Configuration of monosaccharides. erythro and thereo diastereomers. Conversion of glucose into mannose, formation of glucosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D (+)-glucose. Mechanism of mutarotation. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

**Unit-II**
**Chemistry of Enolates**

Acidity of α hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Ethylacetoacetate: Synthesis, Claisen condensation and keto-enol tautomerism. Alkylation of 1,3- dithianes, alkylation and acylation of enamines.

**Unit III**
**Electrochemistry-II**

Types of reversible electrodes, gas metal ion, metal-metal ion, metal insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation and single electrode potential. Standard hydrogen electrode, reference electrodes, standard electrode potential, electrochemical series and its significance. E.M.F and its measurements.Electrolytic and Galvanic cells-reversible and irreversible cells. Calculation of thermodynamic quantities of cell reactions ($\Delta G$, $\Delta H$ and K). Polarization and overvoltage. Concentration cell with and without transport, liquid junction potential. Potentiometric titrations.

**Unit IV**
**Quantum Mechanics**

Black Body Radiation, photoelectric effect, heat capacity of solids, Bohr' s model of hydrogen atom(without derivation) and its defects. de Broglie's hypothesis, Heisenberg' s uncertainty principle, Sinusoidal wave equation. Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box. Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance.
Molecular Orbital Theory: Basic ideas, criteria for forming M.O.'s from A.O.'s. construction of M.O.' s by LCAO method ($H^+$ ion). Hybrid orbitals sp, $sp^2$ and $sp^3$. Calculation of coefficients of atomic orbitals used in these hybrid orbitals.

**Learning Outcomes:**
**Students will be able to :**

- develop scientific skills to describe naturally occurring poly hydroxyl aldehydes and ketones mostly used as energy providing food.
- investigate principles and phenomena of electrochemistry and related devices.

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester V

## Paper III

**SSCH 503** **Analytical Chemistry-V** **45 Hrs (3 hrs/week)**

**UNIT I**
**Electrogravimetry**

Theory, electrode reactions, overpotential, completeness of deposition, electrolytic separation of metals, character of the deposit, electrolytic separation of metals with controlled cathode potential. Electrolytic determinations at constant current-copper and lead. Electrolytic determinations with controlled cathode potential – Antimony, Copper, Lead and Tin in an alloy.

**Coulometry**

Principle of Coulometry, coulometry at controlled potential, separation of Ni and Co by coulometric analysis at controlled potential, coulometry at constant current, coulometric titrations.

**UNIT II**
**Polarography**

Principle and experimental set-up. Diffusion current and half-wave potential, Qualitative and quantitativeapplications of polarogaphy in analytical chemistry-(i) Wave height concentration graph (ii) Internal standard (Pilot ion method)
(iii) Standard addition method (iv) Use of polarography in : (a) Zn and Cu in brass(b) Dissolved oxygen in the sample.

**UNIT III**
**Amperometry**

Amperometric titrations, techniques of amperoetric titrations with the dropping mercury electrode, titrationwith the rotating platinum micro-electrode, biamperometric titrations.
Modified Voltammetric methods: currnet sampled (TAST) polarography, Pulse polarography, differential pulse polarography, cyclic voltammetry,sinusoidal alternating current polarography and stripping voltammetry.

**UNIT IV**
**Mass Spectrometry**

Introduction, instrumentation and techniques, elementary idea about electron impact, chemical ionization and Matrix Assisted Laser Desorption Ionization (MALDI), principle of fragmentation, factors influencing fragmentation, ion analysis, ion abundance. fragmentation modes, determination of molecular formula, mass spectral fragmentation of simple organic compounds- alkanes, alkenes, alkynes, cycloalkanes and arenes, alcohols and ethers, ketones, aldehydes and carboxylic acids. Types of peak: molecular ion peak, isotopic peak, base peak, metastable peak.

**Learning Outcomes:**

**Students will be able to:**

- describe the principle and instrumentation of electrogravimetry and its applications.
- evaluate polarographic, and amperometric methods and find mass spectra of various functional groups.

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester V

**SSCH 551** **Chemistry Practical- V** **90 hrs. (6 hrs/week)**

**Note: Total marks for each semester practical is 150, which includes 90 marks for ESE and60 marks for internal assessment.**

**Duration 5 hours** **Max. Marks: 90**

| | | |
|---|---|---|
| Experiment no. 1 | Inorganic Chemistry | 20 marks |
| Experiment no. 2 | Organic Chemistry | 20 marks |
| Experiment no. 3 | Physical Chemistry | 20 marks |
| Record | | 15 marks |
| Viva voce | | 15 marks |

**Inorganic Chemistry**

Quantitative estimation of any three of the following mixture by Volumetric and Gravimetric methods.

(a) Copper-Zinc
(b) Zinc-Nickel
(c) Iron-Copper
(d) Silver-Nickel
(e) Iron-Zinc
(f) Copper-Nickel

**Organic Chemistry**

Separation and analysis of an organic mixture containing two solid components using water,/$NaHCO_3$,/NaOH and preparation of suitable derivatives.

**Physical Chemistry:**

Molecular weight determination:

(a) Determination of molecular weight of a non volatile solute by Rast method/Beckmann freezing point method.

(b) Determination of the apparent degree of dissociation of an electrolyte (e.g.NaCl) in aqueous solution at different concentrations by ebullioscopy.

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# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester V

**SSCH 551** **Chemistry Practical- V** **90hrs. (6 hrs/week)**

Colorimetry:

Verify Beer- Lambert's law using $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given solution .

pH metric titrations:

(i) Determination of strength of strong acids by titrating it against strong base.
(ii) Determination of strength of strong acids by titrating it against weak base.
(iii) Determination of strength of weak acids by titrating it against strong base.
(iv) Determination of strength of HCl and acetic acid in a mixture of both by titrating it against NaOH.

**Viva voce**

**Record**

**Learning Outcomes:**

**Students will be able to:**

- learn experimentally the separation and analysis of an organic mixture and quantitative estimation of inorganic mixtures by volumetric and gravimetric methods.
- understand the concept of pH metric titrations and Beer- Lambert's law by using $KMnO_4/K_2Cr_2O_7$ solution in laboratory.

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester VI

### Semester Scheme

| up | Paper Code | Paper title | Course Category | Credit | Maximum marks | Minimum marks | ESE in hrs | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory | Practical |
| ) A* | **SSCH** 601 A | Inorganic and Organic Chemistry-VI | DSE | 3 | 75 | 30 | 3 | - |
| | **SSCH** 602 A | Organic and Physical Chemistry-VI | DSE | | | | | |
| ) B* | **SSCH** 601 B | Inorganic and Organic Chemistry-VI | DSE | 3 | 75 | 30 | 3 | - |
| | **SSCH** 602 B | Organic and Physical Chemistry-VI | DSE | | | | | |
| | **SSCH** 603 | Analytical Chemistry-VI | DSE | 3 | 75 | 30 | 3 | |
| | **SSCH** 651 | Chemistry Practical - VI/Field Project/ Internship | DSEP | 6 | 150 | 60 | - | 5 |
| | | | | 15 | | | | |

The details of the courses with code and title assigned are given below:
DSE= Discipline Specific Elective
ESE = End Semester Examination
DSEP= Discipline Specific Elective Practical

**Note: Student has to choose any one elective paper from Group A* (601 A or 602 A) and Group B* (601 B or 602 B).**
**BCHE(H) 603 and BCHE(H) 651 is mandatory.**

### 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 5 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 75 which includes 54 marks for ESE and 21 marks for internal assessment. Maximum marks for a practical paper is 150 which includes 90 marks for ESE and 60 marks for internal assessment.**

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester VI

### Evaluation Scheme

### Theory Paper

Max hrs: 3 hrs. Max. Marks: 75

Attempt all Questions

| | | |
|---|---|---|
| PART A | 7 Questions (very short answer questions) | 7x2= 14marks |
| PART B | 4 Questions (1 question from each unit with internal choice) | 4x10 = 40 marks |
| | **Total marks for End SemesterExamination** | **54 Marks** |
| | **Internal Assessment** | **21 Marks** |
| | **Maximum Marks** | **75 Marks** |
| | **Minimum Marks** | **30 Marks** |

### Practical Paper

Max.Hrs: 5 hrs. Max. Marks: 150

| | | |
|---|---|---|
| Experiment no. 1 | Inorganic Chemistry | 20 marks |
| Experiment no. 2 | Organic Chemistry | 20 marks |
| Experiment no. 3 | Physical Chemistry | 20 marks |
| | Record | 15 marks |
| | Viva voce | 15 marks |
| | Total marks for End Semester Examination | 90 marks |
| | Internal Assessment | 60 marks |
| | **Total** | **150 marks** |

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester VI

**Group A** **Paper I**

**SSCH 601A** **Inorganic and Organic Chemistry-VI** **45 Hrs (3 hrs/week)**

**Unit -I**
**Metal Ligand Bonding and Thermodynamic & Kinetic aspects of Transition Metal Complexes.**

Metal – Ligand Bonding in Transition Metal Complexes: An elementary idea of Crystal-Field Theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal – field parameters, colour of transition metal ions, limitations of Crystal Field Theory.

Thermodynamic and Kinetic aspects of Transition Metal Complexes**:** Thermodynamic and kinetic stability, thermodynamic stability and factors affecting the stability, substitution reactions of square planar complexes and trans effect.

**Unit-II**
**Chemistry of Lanthanide and Actinide Elements**

Chemistry of Lanthanide Elements: Position in periodic table, electronic structure, oxidation states and ionic radii, lanthanide contraction and its consequences, complex formation, spectral properties, magnetic properties, Separation of lanthanides.

Chemistry of Actinide Elements**:** Position in periodic table, electronic configuration, general features and chemistry of actinides, oxidation states and magnetic properties. Chemistry of separation of Np, Pu and Am from U. Comparison of lanthanides and actinides.

**Unit -III**
**Heterocyclic Chemistry-I**

Introduction, Molecular Orbital diagram and aromatic characteristic of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Reaction mechanism of nucleophilic substitution reaction in pyridine derivatives. Comparision of basicity of pyridine, piperidine and pyrrole.

**Unit -IV**
**Polymer Chemistry**

Addition or chain growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol-formaldehyde resin, urea-formaldehyde resin, epoxy resins and polyurethanes. Natural and synthetic rubbers.

**Learning Outcomes:**

**Students will be able to :**

- describe spectroscopy of transition metal complexes and successfully explain magnetic properties, colour and stability of transition metal complexes.
- understand wide applications of heterocyclic compounds in pharmaceutical and agricultural industries.

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester VI

## Paper II

**SSCH 602 A** **Organic and Physical Chemistry-VI** **45 Hrs (3 hrs/week)**

**Unit-I**
**Basics of Green Chemistry**

Introduction, Principle and Concepts of Green Chemistry, Need for Green Chemistry, Twelve principles of Green Chemistry with their explanations and examples, Green chemistry in day to day life.

**Unit-II**
**Synthesis and Synthetic Applications of some Organic Reagents**

Synthesis and Synthetic Applications of some Organic Reagents-DDQ, DCC, Lead tetra acetate, NBS, $TiCl_4$ and Wilkinson catalyst.

**Unit-III**
**Spectroscopy**

Electromagnetic radiation of the spectrum, basic features of different spectrometers, Born Oppenheimer approximation, degree of freedom. Rotational spectrum - derivation and energy levels of rigid rotator & non rigid rotator. Selection rules, isotope effect, spectral intensity, population distribution (Maxwell Boltzmann distribution).
Vibrational spectrum - Infrared spectrum, Energy levels of simple harmonic and anharmonic oscillator, selection rules, pure vibrational spectrum, determination of force constant.
Raman spectrum - Concept of polarizability. Derivation of pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.
Electronic spectrum - Concept of potential energy curves for bonding and anti bonding molecular orbital's, qualitative description of selection rules and Frank –Condon principle.

**Unit IV**
**Physical Properties and Molecular Structure**

Optical activity, polarization (Clausius-Mosotti equation) orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment: temperature method and refractivity method, dipole moment and structure of molecules,magnetic properties paramagnetism, dimagnetism and ferromagnetism.

**Learning Outcomes:**

**Students will be able to :**

- demonstrate skills of safer use of chemicals in pharmaceutics and agriculture.
- understand interaction of electromagnetic radiation with matter as a function of wavelength or frequency.

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester VI

**Group B** **Paper-I**

**SSCH 601 B** **Inorganic and Organic Chemistry-VI** **45 Hrs (3hrs/week)**

**Unit-I**
**Organometallic Chemistry**

Definition, nomenclature and classification of organometallic compounds, preparation, properties, bonding and applications of alkyls and aryls of Al and Ti, a brief account of metal – ethylenic complexes and homogenous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

**Unit-II**
**Basics of Nuclear Chemistry and Radio Chemistry**

Fundamental particles of nucleus. Nuclides- representation and classification of nuclides. Isotopes, isobars and isotones with specific examples. Natural and artificial radioactivity, radioactive disintegration series, radioactive displacement law, radioactivity decay rates, half life and average life.

Fuel of the future Helium-3 ($^{3}$He): natural abundance, human production- Tritium decay and use as nuclear fuel

**Unit-III**

**Nitroalkanes & Nitroarenes**

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes, mechanism of nucleophilic substitution in nitro arenes and their reduction in acidic, neutral and alkaline medium, picric acid. Halonitroarenes - reactivity, structure and nomenclature of amines, physical properties, stereochemistry of amines. Separation of mixture of primary, secondary and tertiary amines, structural features affecting basicity of amines.

**Unit-IV**
**Organosulphur Compounds**

Nomenclature, structural features, methods of formation and chemical reactions of sulphonic acids and sulphonamide.
**S**ulpha Drugs- Methods of formation and applications of Sulpha Drugs: Sulphanilmide, Siphadiazine, Sulphaguanidine, Sulphonal.

**Learning Outcomes:**

**Students will be able to :**

- implement knowledge of nuclear power, medical treatment, carbon dating and isotope labeling.
- demonstrate skills of understanding organometallic compounds and applications of sulpha drugs in life.

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester VI

## Paper II

**SSCH 602 B** **Organic and Physical Chemistry-VI** **45 Hrs (3hrs/week)**

**Unit -I**
**Heterocyclic Chemistry-II**

Introduction to condensed five and six membered hetrocycles. Preparation and reaction of indole, quinoline and isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and Bischler- Napieralski synthesis. Mechanism of electrophilic substitution reaction of indole, quinoline and isoquinoline.

**Unit- II**
**Amino Acids and Proteins**

Classification, structure, acid base behaviour and stereochemistry of amino acids, essential and other protein amino acids. Isoelectric point and electrophoresis. Preparation and reaction of α amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins, levels of protein structure. Protein denaturation / renaturation. Determination of peptide structure, end group analysis, selective hydrolysis of peptides. Classical peptides synthesis, solid phase peptide synthesis.

**Unit III**
**Phase Equilibrium**

Statement and meaning of the terms -phase, component and degree of freedom, Gibbs phase rule, phase equilibria of one component system-water, $CO_2$ and Sulphur systems. Phase equilibria of two component system -simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Freezing mixtures - acetone-dry ice. Solid solutions - Compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-$H_2O$) system, ($FeCl_3$-$H_2O$) system and ($CuSO_4$-$H_2O$) system.
Liquid- liquid mixtures, Raoult's and Henry` s law. Ideal and Non ideal Solutions. Azeotropes- HCl –$H_2O$ and ethanol-water systems. Partially miscible liquids- Phenol-water, trimethylamine-water, nicotine-water systems. Lower and upper consulate temperature. Effect of impurity on consulate temperature. Immiscible liquids, steam distillation. Nernst distribution law- Thermodynamic derivation and applications.

**Unit IV**
**Solutions, Dilute Solutions and Colligative Properties**

Solutions, dilute solutions**:** Ideal and non ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient.

Dilute solution and Colligative properties: Raoult`s law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, elevation in boiling point and depression of freezing point. Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

**Learning Outcomes:**

**Students will be able to :**

- apply concept of phase rule in industries viz. purification of components, food production and alloy industries.
- implement knowledge to investigate building blocks of life, enzymes and hormones.

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Semester VI

**Group C** **Paper III**

**SSCH 603** **Analytical Chemistry -VI** **45 hrs (3hrs/Week)**

**UNIT I**
**Gas Chromatography and HPLC**

Introduction, gas chromatography, detectors, programmed temperature gas chromatography, quantitative analysis by Gas Liquid Chromatography and Gas-Solid Chromatography. High Performance Liquid Chromatographic methods (HPLC) – adsorption chromatography, liquid- liquid partition chromatography, ion exchange and exclusion chromatography

**UNIT II**
**Diffraction Pattern**

Diffraction Patter**n:** Fundamental principle, instrumentation, use of X-ray, electron and neutron in diffractometry and their applications in biological and analytical techniques. Applications of X-rays in C.T. scan.

**UNIT III**
**Automated Methods of Analysis**

Automated Methods of Analysis**:** Automatic instruments and automation. Automation of sampling and preliminary sample treatment for air, water and soil, Continuous flow method, Discrete methods, automatic analysis based on multilayer films

**UNIT IV**
**Nuclear Magnetic Resonance (NMR) Spectroscopy**

Theory of nuclear magnetic resonance, experimental methods of NMR spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin spin splitting and coupling constant, factors affecting coupling constants. areas of signals.
Proton Magnetic Resonance 1H-NMR spectroscopy, Interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate. applications of Proton NMR including applications in MRI technique.

**Learning Outcomes:**

**Students will be able to :**

- understand the concept of automated methods of analysis and apply the use of X-rays in CT Scan.
- explain the theory and instrumentation of spectroscopy and chromatography.

# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester VI

**SSCH 651** **Chemistry Practical-VI/ Field Project/ Internship** **90 hrs. (6 hrs/week)**

**Note: Total marks for each semester practical is 150, which includes 90 marks for ESE and60 marks for internal assessment.**

**Duration 5 hours** **Max. Marks: 90**

| | | |
|---|---|---|
| Experiment no. 1 | Inorganic Chemistry | 20 marks |
| Experiment no. 2 | Organic Chemistry | 20 marks |
| Experiment no. 3 | Physical Chemistry | 20 marks |
| Record | | 15 marks |
| Viva voce | | 15 marks |

**Inorganic Chemistry**

**1.** Qualitative analysis of mixture containing six radicals, one of which should be a rare ion. The mixture may contain radicals of any combinations including interfering acid radicals and insoluble radicals.

**2.** Analysis of any three of the following

(a) Available chlorine in bleaching powder.
(b) Casein in milk sample
(c) Analysis of two components in alloy.
(d) Analysis of cement for Ca and Al or Mg
(e) $MnO_2$ in pyrolusite.

**Organic Chemistry**

1. Two step preparation of simple compounds (any four)

(a) Preparation of p-aminoazabenzene from aniline
(b) Preparation of p-nitroaniline from acetanilde
(c) Preparation of syn-tribromobenzene from aniline
(d) Preparation of m-nitro aniline from nitrobenzene
(e) Preparation of acetanilide from acetophenone (Beckmann Rearrangement)
(f) Preparation of anthranillic acid from phthalic anhydride
(g) Preparation of eosin from phthalic anhydride

2. Analysis of oils and fats (Any one)

(a) Determination of Saponification value.
(b) Determination of iodine value.
(c) Determination of acid value.

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# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

## Semester VI

**SSCH 651** **Chemistry Practical-VI** **90 hrs. (6 hrs/week)**

**Physical Chemistry**

1. Electrochemistry: (Any two)

(a) Determine the strength of the given acid conductometrically using standard alkali solution
(b) Determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically
(c) Study the saponification of ethyl acetate acetate conductometrically.
(d) Determine the ionization constant of a weak acid conductrometrically.
(e) Titrate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4/K_2Cr_2O_7$ as titrant and calculate the redox potential of $Fe^{++}/Fe^{+++}$ system on the hydrogen scale.

2. Refractometry/Polarimetry/ Potentiometry (Multimeters may also be used) **:** **(**Any one)

(a) Verify law of refraction of mixtures using Abbe"s refractometer for glycerol- water system.
(b) Determine the specific rotation of a given optically active compound.
(c) Determination of the strength of a given Ferrous Ammonium Sulphate solution potentiometrically.

3. Chemical Kinetics: ( Any two)

(a) Determine the effect of ionic strength on the rate of persulphate iodide reaction
(b) Determination of molecular weight by Rast Camphor method
(c) Determination of concentration of given solution of $H_2SO_4$ by measuring heat changes during dilution
(d) Compare the cleansing power of two samples of detergent by surface tension measurements
(e) To find the velocity constant of the hydrolysis of methyl acetate catalysed by an acid

**Viva voce**

**Record**

**Learning Outcomes:**

**Students will be able to :**

- cultivate confidence for using various equipments like Refractometer, Polarimeter ,Potentiometer, etc.
- design and carryout scientific experiments and use the concepts of chemistry in real life applications.

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# S.S. Jain Subodh P.G. College, Jaipur

## BACHELOR OF SCIENCE CHEMISTRY (B. Sc. Chemistry)

### Project work/Dissertation

**Course objectives:**

- To develop high order thinking skills
- To acquaint with synthesis methodology
- To understand the analysis of different water samples.
- To empowered students with leadership skills.

**Guidelines:**

Student may opt any one topic given below or any other topic of his/her choice for project or internship:

- Synthesis of commercially used compounds.
- Physico chemical Analysis of different types of water samples.
- Determination of heavy metal ions in different samples by Complexometric titrations.
- Extraction of natural products from various samples.
- Preparation of review articles using publication .
- Visit to any industry nearby vicinity and prepare a report.
- Case study: On specific interest of student.

**Course outcomes:**

Students will be able to :

- analyse different water and food samples.
- empowered with research skills .
- understand the preparation of complexes.
- Learn team work

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