

**VANITA VISHRAM WOMEN'S UNIVERSITY**  
**SCHOOL OF SCIENCE & TECHNOLOGY**  
**DEPARTMENT OF CHEMISTRY**



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

**Syllabus of**

**SEMESTERS 4**

**Core Courses (CC), Skill Enhancement Course (SEC), Discipline Specific  
Elective (DSE)**

**w.e.f. the Academic Year 2023-2024**  
**BACHELOR OF SCIENCE (B.Sc.)**

**Semester-IV**  
**CORE COURSE (CH11390)**

**INORGANIC CHEMISTRY-IV**

**Credits: 2 (Theory)**

**Contact hours per week: 2 (Theory)**

**Course Objectives**

- Improve their ability to understand the fundamentals of chemistry.
- Make students more aware of the chemical properties and behavior of elements.
- Become knowledgeable about the chemistry of elements and their reactions.
- To understand the bonding and structures of noble gases.

**Course Outcomes**

After completing the course, the students will be able to:

- Basic concepts about s and p block elements as well as about noble gases and their properties.

Sr. No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Metal Carbonyls	15	50%
2.	Redox Reactions	15	50%
	<b>Total</b>	<b>30</b>	<b>100</b>

<b>B.Sc. Chemistry Semester-IV</b>	
<b><u>INORGANIC CHEMISTRY-IV</u></b>	<b>2 Hours /week</b>
<b>Topic</b>	<b>Hours</b>
<b>Unit – I</b>	
<b>Metal Carbonyls</b> Mononuclear, Polynuclear, Non-bridged carbonyls, Bridged carbonyls, General methods of preparation of carbonyls, Physical and Chemical properties of metal carbonyls, chromium hexacarbonyl, iron pentacarbonyl, dicobalt octacarbonyl, nickel tetracarbonyl. Structure of CO molecule on the basis of VBT, MOT of CO molecule, EAN rule, Use of IR absorption spectra of metallic carbonyls.	<b>15</b>
<b>Unit – II</b>	
<b>Redox Reactions</b> Oxidation Number and Oxidation State, Calculation of oxidation number of elements, Difference between Oxidation number and Valency, Oxidation and reduction, Redox reaction and Half reaction, Oxidizing agent and reducing agents, Calculation of equivalent weight, Disproportionation reaction, Comproportionation reaction, Direct and Indirect Redox reaction, Importance of redox reaction, Storage Batteries.	<b>15</b>

● **Reference Books:**

1. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N., Earnshaw. Chemistry of the Elements, Butterworth-Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH, 1999.
5. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.
6. Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry Fourth Ed., Pearson, 2010
7. Atkins, P. W and Shriver D. N. Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

# BACHELOR OF SCIENCE (B.Sc.)

## Semester-IV CORE COURSE (CH11400)

### ORGANIC CHEMISTRY-IV

**Credits: 2 (Theory)**

**Contact hours per week: 2 (Theory)**

#### Course Objectives

- The basic concept of Aromaticity.
- Basic uses of reaction mechanisms.
- Understanding the structure, mechanism of reactions of selected heterocyclic compounds.
- Reactivity, stability and reactions of alcohols, phenols, ethers and epoxides.

#### Course Outcomes

After completing the course

- Students will develop an ability to understand the chemistry of Aromatic compounds and industrial applications of heterocycles.
- Students will acquire comprehensive knowledge about alcohols, phenols, ethers, and epoxides, enabling them to comprehend various principles and applications in the field of chemistry.

Sr. No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Aromatic Compounds	15	50 %
2.	Alcohols, Phenols, Ethers and Epoxides	15	50 %
	<b>Total</b>	<b>30</b>	<b>100</b>

## B.Sc. Chemistry Semester-IV

### ORGANIC CHEMISTRY-IV

2 Hours  
/week

#### Topic

Hours

#### Unit – I

##### Aromatic Compounds

15

- a) Aromaticity:** Huckel's rule, aromatic character of arenes, cyclic carbocations/carbanions and Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Crafts alkylation/acylation with their mechanism. Directing effects of substituent groups.
- b) Aromatic Heterocycles:** Introduction to heterocycles and their importance. Nomenclature of ring systems: (a) Trivial System (b) Replacement system (c) Fusion system, (d) Hantzsch-Widman nomenclature, Structure, reactivity and synthesis of Heterocycles: (a) Pyrrole (b) Thiophene (c) Furan (d) Benzofuran (e) Benzopyrrole (f) Benzothiophene.

#### Unit – II

##### Alcohols, Phenols, Ethers and Epoxides

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Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement. Phenols: Preparation and properties; Acidity and factors affecting it, Ring substitution reactions, Reimer-Tiemann and Kolbe's-Schmidt Reactions, Fries and Claisen rearrangements with mechanism. Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and  $\text{LiAlH}_4$ .

#### ● Reference Books:

1. Organic Chemistry, Paula Bruice, Eighth edition, Pearson, 2020.
2. McMurry, J.E. Fundamentals of Organic Chemistry, Seventh edition Cengage Learning, 2013.
3. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press Inc., New York (2001).
4. Organic Chemistry, I. L. Finar, Sixth edition, Pearson, 2002.

5. Morrison, R. N. & Boyd, R. N. Organic Chemistry, 6th Edn., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Organic Chemistry by Bahl & Bahl.
7. "Text book of Organic Chemistry" by P. L. Soni and H. M. Chawla, 26/E, 1995, Sultan Chand & Sons Publication, New Delhi.
8. Topics in Heterocyclic Chemistry. G. W. Gribble. Springer-Verlag Berlin Heidelberg, 2010.
9. Modern Heterocyclic Chemistry. 4 Volume Set. Julio Alvarez-Builla, Juan Jose Vaquero, José Barluenga. Wiley. 2011.

# BACHELOR OF SCIENCE (B.Sc.)

## Semester-IV CORE COURSE (CH11410)

### PHYSICAL CHEMISTRY - IV

**Credits: 2 (Theory)**

**Contact hours per week: 2 (Theory)**

#### Course Objectives

- To understand adsorption concept with applications.
- To understand the concept of Ionic Equilibria and Solubility Product.

#### Course Outcomes

After completing the course, the students will be able to understand:

Theory and significance of :

1. Adsorption isotherms and their significance.
2. Ostwald's dilution law and Debye-Huckel theory in brief.

Sr. No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Adsorption	15	50%
2.	Ionic Equilibria	15	50%
	<b>Total</b>	<b>30</b>	<b>100</b>

## B.Sc. Chemistry Semester-IV

### PHYSICAL CHEMISTRY - IV

2 Hours  
/week

#### Topic

Hours

#### Unit – I

##### **Adsorption:**

Adsorption, Adsorbate and Adsorbent, Adsorption versus Absorption, Mechanism of adsorption, Types of adsorption, Physical Adsorption, Chemisorption, Adsorption of gases by Solids, Factors affecting Adsorption, Surface area, Nature of gas, Effect of temperature and pressure, Heats of Adsorption, Comparison of Physisorption versus Chemisorption Adsorption isotherms, Freundlich Adsorption Isotherm, Langmuir adsorption Isotherm, Derivation of Langmuir, Applications of adsorption

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#### Unit – II

##### **Ionic Equilibria:**

Ostwald's dilution law for strong and weak electrolytes, Experimental verification of Ostwald's law, Limitation of ostwald's law, Theory of strong Electrolytes, Ghosh's formula, Debye-huckel theory, Relaxation Effect, Electrophoretic Effect, Debye-Huckel-Onsager Conductance Equation, Degree of dissociation, The common-ion effect, Factors affecting degree of Dissociation(1) nature of solute, (2) nature of the solvent (3) concentration(4) temperature, Numerical.

15

##### ● **Reference Books:**

1. Atkins P. and De Paula, J. Physical Chemistry Tenth Ed., OUP, 2014.
2. Castellan, G. W. Physical Chemistry 4th Ed., Narosa, 2004.
3. Engel, T. and Reid, P. Physical Chemistry 3rd Ed., Prentice Hall, 2012.
4. Essentials of physical chemistry by A. S. Bhal and G. D. Tuli, Pub : S. Chand
5. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
6. Levine, I. N. Physical Chemistry 6th Ed., Tata McGraw-Hill, 2011.



**BACHELOR OF SCIENCE (B.Sc.)**  
**Semester-IV**  
**CORE COURSE (CH11420)**  
**CHEMISTRY PRACTICAL- IV**

**Credits: 3 (Practical)**

**Contact hours per week: 6 (Practical)**

**Course Objectives**

- To perform adsorption desorption equilibrium in the real system.
- To utilize pH metry for acid-base titration.
- To determine the heat of solution.
- To understand the basics of Solvent Preparation and standardization.

**Course Outcomes**

After completing the course, the students will be able to apply:

- adsorption equilibrium in the real system.
- pH metry for acid-base titration.
- To determine the heat of solution.
- To conduct experiments and interpret results, while observing responsible and ethical scientific conduct.

**Inorganic Chemistry Practicals**

- Volumetric Analysis (Any Three)
  1. To determine the amount of Nickel by EDTA.
  2. To determine the amount of Copper by EDTA.
  3. To determine the amount of Zinc by EDTA.
  4. Determination of total hardness of water by EDTA.

**Organic Chemistry Practicals**

- Preparation of Solutions and their standardization using primary standard solutions/ standardised solution.
  1. NaOH/KOH
  2. KMnO<sub>4</sub>
  3. Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> solution.
- Organic Estimations (Minimum Three).
  1. To determine the amount of acetamide in the given solution hydrolysis by NaOH.
  2. To determine the amount of phenol/ Aniline in the given solution by bromination.
  3. To determine the number of -COOH groups of given carboxylic acid.
  4. To determine the percentage purity of l-ascorbic acid (Vitamin-c).
  5. To determine the amount of Glycine in the given solution.

### Physical Chemistry Practicals (Any Three)

1. Adsorption: To study the adsorption of given organic acid (acetic acid/oxalic acid) on animal charcoal.
2. pH metry: To determine the normality of weak acid pH metrically using a strong base.
3. Relative Strength: To determine the relative strength of  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$  acids.
4. Heat of Solution: To determine the Heat of solution of organic acid (benzoic acid, phthalic acid) by finding the solubility of the acid at two different temperatures.

### ● Reference Books:

- Quantitative analysis by R.A. Day and A.L. Underwood.
- Vogel's qualitative organic analysis.
- Elementary Practical Organic Chemistry Part-III Quantitative Organic Analysis by A. I. Vogel.
- Practical Pharmaceutical Chemistry by A. H. Beckett, Volume I & II.

# BACHELOR OF SCIENCE (B.Sc.)

## Semester-IV

### Skill Enhancement Courses (CH15040)

#### Intellectual Property Right (IPR)

**Credits: 2 (Theory)**

**Contact hours per week: 2 (Theory)**

#### Course Objectives

- Gain a comprehensive knowledge of Intellectual Property Rights (IPR) and their economic importance, including copyrights and patents in India and globally, along with their impact on trade and innovation.
- Understand the relationship between IPR and international agreements like WTO, TRIPS, WIPO, GATT, GATS, Madrid Protocol, Berne Convention, and Budapest Treaty, examining their objectives and rights.
- Acquire insights into the procedures and implications of obtaining patents, working with patents, copyright protection and their legal aspects.

#### Prerequisites

- Basic Understanding of Chemistry concepts, including chemical bonding and functional groups.
- Familiarity with General Laws and Regulations, especially in the context of intellectual property rights.
- Basic idea of terminology and basic computer skills for effective communication and case study.

#### Course outcomes

After completion of the course, the learner shall be able to apply knowledge of good laboratory practices and common laboratory procedures for better handling of chemistry laboratory,

Sr. No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Introduction to Intellectual Property Right (IPR)	15	50%
2.	Patents, Copyrights and Trademarks	15	50%
	<b>Total</b>	<b>30</b>	<b>100</b>

## B.Sc. Chemistry Semester-III

### Intellectual Property Right (IPR)

2 Hours  
/week

#### Topic

Hours

#### Unit – I

##### Unit I: Introduction to Intellectual Property Right (IPR)

Copyright Act and IPR, Economic importance. IPR in India and world: Genesis and scope, some important examples. IPR and WTO (TRIPS, WIPO). Objectives, Rights, (a) World Trade Organization (WTO): (i) General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement (ii) General Agreement on Trade related Services (GATS) (iii) Madrid Protocol (iv) Berne Convention (v) Budapest Treaty (b) Paris Convention Patent Act 1970 and its amendments.

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#### Unit – II

##### Unit II: Patents, Copyrights and Trademarks

Procedure of obtaining patents, working of patents. Infringement of patents, Copyrights: work protected under copyright laws, Rights, Transfer of Copyright, Infringement. Trademarks: Objectives of trademarks, Types, Rights, Protection of goodwill, Infringement, Passing off, Defenses, Domain name, Introduction to Trade Secrets, Historical Perspectives, Scope of Protection, Risks involved and legal aspects of Trade Secret Protection. Current challenges and opportunities for the chemistry-using industries, role of chemistry in India and global economies. Financial aspects of business with case studies.

15

#### ● Reference Books:

1. Acharya, N.K. Textbook on intellectual property rights, Asia Law House (2001).
2. Guru, M. & Rao, M.B. Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).
3. Ganguli, P. Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).
4. Miller, A.R. & Davis, M.H. Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
5. Watal, J. Intellectual property rights in the WTO and developing countries, Oxford University Press, New Delhi.

# BACHELOR OF SCIENCE (B.Sc.)

## Semester-III DSE I (CH14190)

### General Chemistry-I

**Credits: 2 (Theory)**

**Contact hours per week: 2 (Theory)**

#### Course Objectives

- To analyze Inorganic compounds by quantitative methods.
- Make students more aware of the units of solution.
- To aware students about laboratory safety and hazards.

#### Course Outcomes

After completing the course, the students will be able to understand:

- Basic concepts of Inorganic qualitative analysis.
- Importance of units in solution preparation.
- To prepare standard Solutions.

Sr. No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	[A] Basic principle of Qualitative Analysis [B] Laboratory Hygiene and Safety	15	50 %
2.	Units of Solution and Standard Solution	15	50 %
	<b>Total</b>	<b>30</b>	<b>100</b>

## B.Sc. Chemistry Semester-IV

### General Chemistry-I

2 Hours  
/week

#### Topic

Hours

#### Unit – I

##### [A] Basic principle of Qualitative Analysis

1. Dry reaction: theory behind borax bead test with equation, Flame test [Theory, structure of non luminous Bunsen flame]
2. Analysis of cation: (a) Application of Common ion effect and Solubility product constant. (b) Complexometric reaction involved in qualitative analysis
  1. For identification [Reaction between Cu(II) ion with ammonia, Fe(III) with thiocyanide, NH<sub>4</sub><sup>+</sup> with Nessler reagent.
  2. For masking [Cd<sup>2+</sup>, Cu<sup>2+</sup>]
  3. Separation of two ion [Ag-Hg, Zn<sup>2+</sup>, Mn<sup>2+</sup>]

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##### [B] Laboratory Hygiene and Safety

1. Handling of chemicals [Carcinogenic chemical, Toxic and poisonous chemicals ]
2. General procedure for avoiding accidents [Apron, Safety goggles, Gloves pipetting process ]
3. First aid technique [ Organic substance in skin, Acid on clothing, Burns in eyes, Inhalation of toxic vapors etc... ]

#### Unit – II

##### Units of Solution and Standard Solution

A) Definitions of terms: Solute, Solvent, and Solution Composition of solution-normal solution, molar solution, molal solution, mole fraction, % solution, saturated, unsaturated and supersaturated solution and solubility. Effect of temp. on various units of concentration. Inter conversion of one unit into another unit. Preparation of solutions of some primary standard substances (e.g. Oxalic acid, Succinic acid, KHP, K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, As<sub>2</sub>O<sub>3</sub>).

Standardisation of the following solution using primary standard solutions/standardised solution.

1. NaOH/KOH
2. I<sub>2</sub> solution
3. KMnO<sub>4</sub>
4. Acids
5. Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> solution

15

● **Reference Books:**

1. Quantitative analysis by R.A. Day and A.L. Underwood.
2. Vogel's qualitative inorganic analysis.
3. Practical Pharmaceutical Chemistry by A. H. Beckett, Volume I & II.

# BACHELOR OF SCIENCE (B.Sc.)

## Semester-IV

### DSE II (CH14200)

#### Pharmaceutical Chemistry-II

**Credits: 2 (Theory)**

**Contact hours per week: 2 (Theory)**

#### Course Objectives

- Provide an introduction to unit process and unit operation in pharmaceutical chemistry.
- Discuss construction of a pharmaceutical manufacturing plant.
- To understand the common processes used in manufacturing of drug formulations.
- To make students understand the different dosage forms.
- Consider the basic pharmaceuticals for drug formulations.

#### Course Outcomes

- After completing this paper, students will have the ability to comprehend design, construction and safety measures of pharmaceutical manufacturing plants, common processes used in manufacturing of drug formulations, different dosage forms as well as basic pharmaceuticals for drug formulations

Sr. No.	Unit	Minimum No. of Contact Hours	Weightage in %
1.	Unit Process and Unit Operation in Pharmaceutical Chemistry	15	50%
2.	Pharmaceutics	15	50%
<b>Total</b>		<b>30</b>	<b>100</b>



<b>B.Sc. Chemistry Semester-III</b>	
<b>Pharmaceutical Chemistry-II</b>	<b>2 Hours /week</b>
<b>Topic</b>	<b>Hours</b>
<b>Unit – I</b>	
<p><b>Unit Process and Unit Operation in Pharmaceutical Chemistry:</b></p> <p>Design, construction and safety measure of pharmaceutical manufacturing plant; Principles involved and technique employed in drying, granulation, filtration, milling distillation, control of humidity, refrigeration, air conditioning, piping and stages, GMP and GMT.</p>	15
<b>Unit – II</b>	
<p><b>Pharmaceutics</b></p> <p><b>(a) Tablet:</b> Definition, formulation and compounding; Wet and dry granulation methods, slugging and capping of tablets, coating of tablets. <b>(b) Capsule:</b> Materials for production of hard gelatin capsules, Methods of capsule filling, Importance evaluation of capsules. <b>(c) Ointments:</b> Definition and classification, Factors affecting skin absorption, Ointments bases. <b>(d) Parenteral Products:</b> Definition and types of parenteral products. <b>(e) Emulsion and Aerosols:</b> Definition and classification, Theory of emulsions, Emulsifications and emulsifying agents, Types of emulsifying agents, Sedimentation testing, preparing equipments, Packing and storage.</p>	15

● **Reference Books:**

- E.W. Martin, Husa's Pharmaceutical; Dispensing, Mack Publishing. Co.
- Essentials of Pharmaceutical Chemistry (3rd ed) D. Cairns, Pharmaceutical Press, London, 2003.
- Pharmaceutical Chemistry, Editors Jill Barber and Chris Rostron, Oxford University Press, 2013.

- A. Burger, Medicinal Chemistry and drug Discovery, Wiley- Interscience.
- B.G Katzung, Basic and Clinical pharmacology, 9th edition, McGraw-Hill, New York.
- L. Lachman, The Theory and Practice of Industrial Pharmacy, 3rd Indian edition. Varghese Publishing House, Bombay.
- W.O. Foye, Principles of Medicinal Chemistry, 3rd edition, Barghese Publishing House, Bombay.
- A. White, P. Handler and E.L. Smith, Principles of Biochemistry, McGraw-Hill.
- M. Mesbahuddin and M.R. Islsm, General Principles of Pharmacology, Bengal Library, Dhaka.
- A.J. Winfield, J. A Rees, I. Smith, Pharmaceutical Practice, 4th edition, Elsevier publication.
- Cooper and Gunn's, Dispensing for Pharmaceutical students, ed. S.J. Carter, 12th edition. CBS Publisher..
- C.V.S, S. Pharmaceutical engineering, Principles and Practice, Vallabh Prakashan.
- K.S. Pharmaceutical Engineering New age International publisher.
- P., M. Elementary Chemical engineering, Tata Mac Graw Hill.