# SYLLABI AND SCHEME OF EXAMINATIONS FOR

**(MULTIDISCIPLINARY COURSE FOR UNDER GRADUATE PROGRAMS OFFERED BY THE DEPARTMENT OF CHEMISTRY)**

# B.Sc. (Life Sciences/Physical Sciences) with Hons. in Chemistry

**(Based on Curriculum and Credit Framework for UG Programs under NEP)**

# WITH EFFECT FROM THE SESSION 2024-25

# MAHARSHI DAYANAND UNIVERSITY ROHTAK (HARYANA)

# SCHEME OF EXAMINATIONS FOR MULTIDISCIPLINARY COURSE OFFERED BY THE DEPARTMENT OF CHEMISTRY

## B.Sc. (Life Sciences/Physical Sciences Program)

| Name of the Department | Nomenclature of Multidisciplinary Course (MDC) @ 3 credits | Course Code | Credits Distribution | | | Total Credits | Workload | | | Total Workload | Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | L | T | P | | Theory | | Practical | | |
| | | | | | | | | | | | Internal | External | Internal | External | |
| Semester I (Session 2024-25) | | | | | | | | | | | | | | | |
| **Chemistry** | MDCI-Basics of Chemistry | **24CHEX01MD01** | 2 | 0 | 0 | **03** | 2 | 0 | 0 | **04** | 15 | 35 | --- | --- | **75** |
| | MDC Chemistry Practical-I | | 0 | 0 | 1 | | 0 | 0 | 2 | | --- | --- | 05 | 20 | |
| Semester II (Session 2024-25) | | | | | | | | | | | | | | | |
| **Chemistry** | MDCII-Essentials of Chemistry | **24CHEX02MD01** | 2 | 0 | 0 | **03** | 2 | 0 | 0 | **04** | 15 | 35 | --- | --- | **75** |
| | MDC Chemistry Practical-II | | 0 | 0 | 1 | | 0 | 0 | 2 | | --- | --- | 05 | 20 | |
| Semester III (Session 2025-26) | | | | | | | | | | | | | | | |
| **Chemistry** | MDCIII-Core Chemistry | **25CHEX03MD01** | 2 | 0 | 0 | **03** | 2 | 0 | 0 | **04** | 15 | 35 | --- | --- | **75** |
| | MDC Chemistry Practical-III | | 0 | 0 | 1 | | 0 | 0 | 2 | | --- | --- | 05 | 20 | |

**Note:**

A student has to opt for three Life Sciences/Physical Sciences Courses in first three semester from the pool of the courses offered in the disciplines other than those of Major disciplines and Minor disciplines and the one not studied at 10+2 or equivalent level.

# Syllabi for Multidisciplinary Course Offered by the Department of Chemistry

# B.Sc. (Life Sciences/Physical Sciences Program)

**Semester — I (Session: 2024- 25)**

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|---|---|---|---|
| **Name of Program** | **B.Sc. (Life Sciences/Physical Sciences)** | **Program Code** | **UMLS4 or UMPS4** |
| **Paper No.** | **MDC Paper – I** | **Nomenclature** | **Basics of Chemistry** |
| **Name of the Course** | **Multidisciplinary Course** | **Course Code** | **24CHEX01MD01** |
| **Credits** | **02** | **Maximum Marks** | **50** |
| **Hours per Week** | **02** | **External Marks** | **35** |
| **Duration of Examination** | **02 Hrs.** | **Internal Marks** | **15** |

**Course Objectives:** The course aims to provide a foundational understanding of basic chemistry concepts such as Dalton's atomic theory, atomic structure, chemical reactions and states of matter. It is also infused with the atomic models, electronic configurations and laws governing gases, liquids and solids. Additionally, it explores practical applications of chemistry in everyday life, including the classification of drugs, food additives and cleansing agents like soaps and detergents.

***Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.***

**Course Learning Outcomes (CLO):** By the end of the course, the students will be able to:
**CLO1:** Understand the fundamental principles of chemistry and classification of matter.
**CLO2:** Demonstrate proficiency in molecular mass calculations and the mole concept for quantifying substances.
**CLO3:** Express chemical formulas in molecular, empirical and structural form.
**CLO4:** Describe the structure of atoms in terms of protons, neutrons and electrons.
**CLO5**: Comprehend different models of atom, quantum numbers and the stability of orbitals.
**CLO6:** Demonstrate a thorough understanding of the fundamental gas laws.
**CLO7:** Understand characteristics of solids and liquids including their structures, densities and phase transitions.
**CLO8:** Know about drugs, food adulterants and preservatives.

**Unit–I**

**Basic Concepts of Chemistry**

Introduction, Dalton atomic theory, concept of atom, element and molecule, matter and its classification, chemical reactions, empirical and molecular formula, atomic mass, molecular mass, mole concept, ways of expressing concentration of solutions (molarity, normality, molality, mole fraction, strength).

| Unit–II |
|---|
| **Atomic Structure**<br>Thomson's model, Rutherford's model, Bohr's model, electron, proton, neutron and their characteristics, atomic number, atomic mass, isotopes, isobars and isotones, dual nature of matter and light, de Broglie's relationship, Heisenberg Uncertainty principle, concept of orbit and orbital, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in the orbitals (Aufbau principle, Pauli exclusion principle and Hund's rule), electronic configuration of atoms, extra stability of half-filled and completely filled orbitals. |
| **Unit–III** |
| **States of Matter**<br>Introduction to the three states of matter and intermolecular interactions. Gaseous state: Boyle's law, Charles' law, Gay Lussac's law and Avogadro's Law with practical implications. Elementary idea of kinetic energy, molecular speeds, ideal gas equation and deviation from ideal behavior.<br>Liquid state: Melting and boiling points, vapor pressure, viscosity and surface tension.<br>Solid state: General characteristics of solid state, crystalline and amorphous solids, classification of crystalline solids. |
| **Unit–IV** |
| **Chemistry in Everyday Life**<br>Drugs and their classification with suitable examples, food adulterants and preservatives, artificial sweetening agents, antioxidants, soaps and detergents and their cleansing action. |
| **Books Recommended/References:** |
| 1. Text Books of N.C.E.R.T for 11th and 12th class.<br>2. Principles of Physical Chemistry by M. S. Pathania, B. R. Puri and L. R. Sharma.<br>3. Advanced Physical Chemistry by G. Raj.<br>4. Chemistry in Everyday Life by R. Tyagi.<br>5. A Textbook of Organic Chemistry by B. S. Bahl and A. Bahl.<br>6. Chemistry in Everyday Life by O. P. Agarwal. |

| **Name of Program** | **B.Sc. (Life Sciences/Physical Sciences)** | **Program Code** | **UMLS4 or UMPS4** |
|---|---|---|---|
| **Paper No.** | **MDC Paper – I** | **Nomenclature** | **MDC Chemistry Practical – I** |
| **Name of the Course** | **Multidisciplinary Course** | **Course Code** | **24CHEX01MD01** |
| **Credits** | **01** | **Maximum Marks** | **25** |
| **Hours per Week** | **02** | **External Marks** | **20** |
| **Duration of Examination** | **02 Hrs.** | **Internal Marks** | **05** |

**Course Objectives:** This course aims to provide a fundamental knowledge of calibration and use of apparatus, preparation of solution of titrants of different molarity/normality, acidity and basicity. It further develops a clear understanding of pH and its determination. Students will gain a comprehensive understanding of the fundamental principles of distillation. This course also provides an overview of the purification of organic compounds and the criteria of purity.

***Note: Examiner will set two experiments for practical examinations*.** **(7×2) Marks**

**Course Learning Outcomes (CLO):** By the end of the course, the students will be able to:
**CLO1:** Prepare different types of solution.
**CLO2:** Calibrate and use the apparatus properly.

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| **CLO3:** Purify the water samples and determine their pH, acidity and basicity.<br>**CLO4:** Analyse the pH of soil samples.<br>**CLO5:** Learn lime water test.<br>**CLO6:** Check adulteration in different food materials. |
| **List of Experiments** |
| 1. Titrimetric analysis:<br>a) Calibration and use of apparatus.<br>b) Preparation of solution of different molarity/normality.<br>2. To check acidity, alkalinity and pH of water by litmus paper or pH strips.<br>3. To determine pH of soil.<br>4. Lime water test: for the detection of $CO_2$.<br>5. Checking the adulteration in given food materials (Milk, edible oil, sugar, turmeric and chilli powder).<br>6. To obtain pure water from impure water containing ink by simple distillation method. |
| **Viva-Voce** **(03 Marks)** |
| **Note Book** **(03 Marks)** |
| **Books Recommended/References:** |
| 1. Laboratory Manual Chemistry of NCERT for class $11^{th}$ and $12^{th}$.<br>2. Food Processing and Preservation by G. Subbulakshmi.<br>3. Basic Concepts: Physical Chemistry Experiments by N. Seedher.<br>4. B.Sc. Chemistry Practical by S. Goyal. |

**Semester — II (Session: 2024- 25)**

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| **Name of Program** | **B.Sc. (Life Sciences/Physical Sciences)** | **Program Code** | **UMLS4 or UMPS4** |
| **Paper No.** | **MDC Paper – II** | **Nomenclature** | **Essentials of Chemistry** |
| **Name of the Course** | **Multidisciplinary Course** | **Course Code** | **24CHEX02MD01** |
| **Credits** | **02** | **Maximum Marks** | **50** |
| **Hours per Week** | **02** | **External Marks** | **35** |
| **Duration of Examination** | **02 Hrs.** | **Internal Marks** | **15** |

**Course Objectives:** The course aims to provide a comprehensive understanding of classification of elements and periodic properties, emphasizing on the importance of the periodic table and periodic trends. Additionally, it covers the utility of hydrocarbons in daily life, including their nomenclature, structure and use as fuels. Furthermore, the course includes polymers, their classification, synthesis methods and environmental implications, including strategies for pollution control.

***Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.***

**Course Learning Outcomes (CLO):** By the end of the course, the students will be able to:

**CLO1:** Understand the periodic law and periodic trends.

**CLO2:** Solve the conceptual questions using the knowledge gained by studying periodicity in atomic radii, ionic radii, ionization energy and electron affinity of elements.

**CLO3:** Know the classifications of different hydrocarbons in alkanes, alkenes, alkynes and aromatic hydrocarbon.
**CLO4:** Differentiate the physical and chemical properties of different hydrocarbon.
**CLO5:** Understand the preparation and uses of polymers.
**CLO6:** Classify the different types of polymers including natural, synthetic, biodegradable and non-biodegradable etc.
**CLO7:** Know about cause and effect of environmental pollution.
**CLO8:** Explain the global warming, acid rain, green-house effect and smog formation etc.

**Unit–I**

**Classification of Elements and Periodic Properties**

Importance of classification of elements, overview and history of periodic system, modern periodic law and periodic table, periodic properties of elements, atomic and ionic size, ionization energy, electron affinity and electronegativity.

**Unit–II**

**Hydrocarbons and their Utility in Daily Life**

Introduction of hydrocarbons, classification of hydrocarbons, types of hydrocarbons(aliphatic and aromatic hydrocarbons).

Nomenclature, structure, physical properties of alkanes, alkenes and alkynes and their uses in everyday life. Aromatic hydrocarbons- Nomenclature, structure of benzene, resonance and aromaticity. Combustion and pyrolysis, hydrocarbon as fuels (natural gas, petrol, LPG, kerosene, diesel and CNG.)

**Unit–III**

**Polymer**

Introduction to polymers, classification of polymers, natural and synthetic polymers, biodegradable and non-biodegradable polymers, methods of polymerization (addition and condensation polymers), preparation and use of polythene, nylon, PVC, teflon and bakelite.

**Unit–IV**

**Environmental Chemistry**

Causes and effects of air, water and soil pollution, greenhouse effect and global warming, smog formation, acid rain, depletion of ozone layer, pollution due to industrial waste, strategies to control environmental pollution.

**Books Recommended/References:**


1. Text Books of N.C.E.R.T for $11^{th}$ and $12^{th}$ class.
2. Textbook of Inorganic Chemistry by O. P. Tandon.
3. Organic Chemistry by M. S. Chouhan.
4. Polymer Science by V. R. Gowariker, N. V. Viswanathan and J. Sreedhar.
5. Environmental Chemistry by B. K. Sharma and M. Sharma.


| **Name of Program** | **B.Sc. (Life Sciences/Physical Sciences)** | **Program Code** | **UMLS4 or UMPS4** |
|---|---|---|---|
| **Paper No.** | **MDC Paper – II** | **Nomenclature** | **MDC Chemistry Practical – II** |
| **Name of the Course** | **Multidisciplinary Course** | **Course Code** | **24CHEX02MD01** |
| **Credits** | **01** | **Maximum Marks** | **25** |
| **Hours per Week** | **02** | **External Marks** | **20** |

| Duration of Examination | 02 Hrs. | Internal Marks | 05 |
|---|---|---|---|

**Course Objectives:** This course provides the understanding of pH measurement. Students will be able to understand the chemistry behind the suspected bribery case. It further helps students to prepare hand sanitizer and shampoo. Students will be able to determine acid value of oils and fats. Also able to determine chloride in water sample.

***Note: Examiner will set two experiments for practical examinations*.** **(7×2) Marks**

**Course Learning Outcomes (CLO):** By the end of the course, the students will be able to:
**CLO1:** Determine the nature of some salt solutions and their pH values.
**CLO2:** Understand chemistry of phenolphthalein used in suspected bribery case.
**CLO3:** Prepare the hand sanitizer.
**CLO4:** Determine $R_f$ value of oils and fats.
**CLO5:** Determine chloride in water sample by $AgNO_3$ method.
**CLO6:** Determination of carbonates and bicarbonates in given solution.

**List of Experiments**

1. Determination of the pH and nature of solution of some salts using pH paper or universal indicator. ($NH_4Cl$, $Na_2CO_3$, $CH_3COONa$, NaCl, unknown salt).
2. Chemistry of phenolphthalein used in suspected bribery case: A forensic investigation.
3. Preparation of hand sanitizer.
4. Determination of retention factor ($R_f$ value) of oils and fats.
5. Determination of chloride in water sample by $AgNO_3$ method.
6. Determination of carbonates and bicarbonates in given solution.

**Viva-Voce** **(03 Marks)**

**Note Book** **(03 Marks)**

**Books Recommended/References:**


1. Practical Chemistry by O. P. Pandey, D. N. Bajpai and S. Giri.
2. Dissociation of phenolphthalein helps in solving Bribe Trap Case: Forensic approach by R. Verma and S. Manik.
3. Hand Sanitizer, Easy Guide to Make Anti-Bacterial and Anti-Viral Homemade Hand Sanitizers by H. Miller.
4. Practical Organic Chemistry – A Primer by V. Peesapati.
5. Practical Organic Chemistry by A. K. Manna.


## Semester — III (Session: 2025- 26)

| Name of Program | B.Sc. (Life Sciences/Physical Sciences) | Program Code | UMLS4 or UMPS4 |
|---|---|---|---|
| Paper No. | MDC Paper – III | Nomenclature | Core Chemistry |
| Name of the Course | Multidisciplinary Course | Course Code | 25CHEX03MD01 |
| Credits | 02 | Maximum Marks | 50 |
| Hours per Week | 02 | External marks | 35 |
| Duration of Examination | 02 Hrs. | Internal Marks | 15 |

**Course Objectives:** The course aims to elucidate the types of chemical bonding, including ionic, covalent, coordinate, hydrogen bonding and Van der Waals interactions. It covers valence electrons, hybridization, molecular shapes, VSEPR theory and molecular orbital theory. Additionally, it explores organic chemistry principles, corrosion mechanisms and biomolecules such as carbohydrates, proteins and nucleic acids, emphasizing their structures, functions and significance in biological processes.

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| ***Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.*** |
| **Course Learning Outcomes (CLO):** By the end of the course, the students will be able to:<br>**CLO1:** Understand the types of chemical bonding.<br>**CLO2:** Explain the concepts of atomic orbitals, molecular orbitals and hybridization.<br>**CLO3:** Understand the basic principles of organic chemistry.<br>**CLO4:** Define types of organic reactions, electrophiles and nucleophiles, bond fission and different electronic effects.<br>**CLO5:** Classify corrosion into different types based on mechanisms and appearance.<br>**CLO6:** Know the causes and prevention of corrosion.<br>**CLO7:** Know the types and functions of biomolecules.<br>**CLO8:** Describe the diversity of biomolecules and their roles in cellular structure, metabolism and genetic information storage. |
| **Unit–I** |
| **Chemical Bonding**<br>Types of chemical bonding- ionic bond, covalent bond, coordinate bond, hydrogen bonding, Van der Waals interactions, Valence bond theory, concept of hybridization and shapes of simple molecules, VSEPR theory, Molecular orbital theory. |
| **Unit–II** |
| **Basic Principles of Organic Chemistry**<br>Types of organic reactions, electrophiles and nucleophiles, homolytic and heterolytic fission of a covalent bond, inductive effect, electromeric effect and resonance effect. |
| **Unit–III** |
| **Corrosion**<br>Introduction and causes of corrosion, types of corrosion, dry and wet corrosion, factors affecting corrosion, methods to prevent corrosion. |
| **Unit–IV** |
| **Biomolecules**<br>Carbohydrates- Classification of carbohydrates, structure and importance of monosaccharides, importance of disaccharides and polysaccharides.<br>Proteins- Amino acids, peptide linkage, primary, secondary, tertiary and quaternary structure of proteins, importance of proteins, denaturation of proteins.<br>Nucleic Acids- Structure and function of DNA and RNA. |
| **Books Recommended/References:** |
| 1. NCERT Chemistry Textbook for class $11^{th}$ and $12^{th}$.<br>2. Inorganic Chemistry by O. P. Tandon.<br>3. Organic Chemistry by M. S. Chouhan.<br>4. Corrosion and Corrosion Control R. K. Upadhyay.<br>5. Biochemistry by U. Satyanarayana and U. Chakrapani. |

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|---|---|---|---|
| **Name of Program** | **B.Sc. (Life Sciences/Physical Sciences)** | **Program Code** | **UMLS4 or UMPS4** |
| **Paper No.** | **MDC Paper – III** | **Nomenclature** | **MDC Chemistry Practical – III** |

| Name of the Course | Multidisciplinary Course | Course Code | 25CHEX03MD01 |
|---|---|---|---|
| **Credits** | **01** | **Maximum Marks** | **25** |
| **Hours per Week** | **02** | **External marks** | **20** |
| **Duration of Examination** | **02 Hrs.** | **Internal Marks** | **05** |

**Course Objectives:** The aim of this paper is to make the students learn about the purity of organic compounds. This course will also help the students to understand role of emulsifying agent in stabilizing the emulsion of an oil. It also encompasses the detection of alcohol and $CO_2$. It also includes the preparation of colloidal solution.

***Note: Examiner will set two experiments for practical examinations*.** **(7×2) Marks**

**Course Learning Outcomes (CLO):** By the end of the course, the students will be able to:

**CLO1:** Check purity of organic compounds.
**CLO2:** Understand role of emulsifying agent in stabilizing the emulsion of an oil.
**CLO3:** Explain the alcohol detection test by ester formation.
**CLO4:** Understand the significance of the alcohol detection test in various industries, including food and beverage, pharmaceuticals and cosmetics.
**CLO5:** Prepare colloidal solution of starch and albumin each.
**CLO6:** Determination of carbonates and bicarbonates in given solution.

**List of Experiments**

1. To check the purity of compounds (determination of melting and boiling points).
2. Study of role of emulsifying agent in stabilizing the emulsion of an oil.
3. Alcohol detection test by ester formation (fruity smell).
4. Preparation of colloidal solution of starch and albumin each.
5. Determination of carbonates and bicarbonates in given solution.

**Viva-Voce** **(03 Marks)**

**Note Book** **(03 Marks)**

**Books Recommended/References:**


1. Basic Concepts: Physical Chemistry Experiments by N. Seedher.
2. Senior Practical Physical Chemistry by B.D. Khosla.
3. Practical Chemistry by O. P. Pandey, D. N. Bajpai and S. Giri.
4. Practical Organic Chemistry – A Primer by V. Peesapati.
5. Practical Organic Chemistry by A. K. Manna.