

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (I Semester)**  
**MCHCC-101: INORGANIC CHEMISTRY – I**

**Objectives:** The students will be able to describe wave mechanics and origin of quantum theory which helps in development of skill regarding basic concept of matter. They will learn how to give the systematic names of simple coordination compounds. The students will be able to explain the preparation of Sulphur, Nitrogen and Phosphorus compounds which impart employability in chemical industries.

**UNIT-I** **(09 Sessions)**

Wave mechanics:

Origin of quantum theory, black body radiation, atomic spectra, photoelectric effect, and matter waves, wave nature of the electron, the wave equation, the theory of hydrogen atom.

**UNIT-II** **(09 Sessions)**

Metal  $\pi$  complexes and Metal Clusters:

Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls, Compounds with metal- metal multiple bonds, Boranes, Carboranes, Wade's rule for providing employability in chemical industries.

**UNIT-III** **(09 Sessions)**

Sulphur, Nitrogen and Phosphorus:

Sulphur-Nitrogen compounds: Tetra sulphur tetra nitride, disulphur dinitride and polythiazyl.  $S_xN_y$  compounds. S-N cations and anions. Other S-N compounds. Sulphur-phosphorus compounds: Molecular sulphides such as  $P_2S_3$ ,  $P_4S_7$ ,  $P_4S_9$  and  $P_3S_{10}$ . Phosphorus-nitrogen compounds: Phosphazenes. Cyclo and linear Phosphazenes. Study of other P-N compounds. Boron-nitrogen compounds: Borazine, substituted borazines and boron nitride which impart employability in chemical industries

**UNIT-IV** **(09 Sessions)**

Chemistry of transition elements:

General characteristic properties of transition elements, nomenclature of coordination compounds, Werner's theory, splitting of d-orbitals in low and high symmetry environments, Jahn- Teller effect, metal clusters, sandwich compounds to develop employability skill in chemical industries.

**Course Outcomes:**

Students completing this course will be able to:

- CO1: Understand basic concepts of wave mechanics and origin of quantum theory for skill development at local level.
- CO2: Understand the relationship between the structure, chemical bonds and chemical properties in carbonyl compounds.
- CO3: Define the structure and preparation of sulphur, nitrogen and phosphorous compounds.
- CO4: Understand the systematic names of simple coordination compounds.

**Suggested Readings:**

1. Inorganic Chemistry by J. E. Huheey
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. Organic Chemistry by Morrison and Boyd
4. Concise Inorganic Chemistry by J. D. Lee

## 5. The Organometallic Chemistry of Transition Metals: John Wiley

### Web Sources:

- <https://bookboon.com/en/chemistry-ebooks>
- <https://www.pdfdrive.com/msc-inorganic-chemistry-e11145894.html>
- <https://ocw.mit.edu/courses/chemistry/5-12-organic-chemistry-i-spring-2003/lecture-handouts/>

**Note: Latest edition of all the suggested readings must be used.**

### Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 3   | 1   | 3   | 1   | 1   | 1   | 1   | 1   | 2    | 3    | 2    |
| CO2 | 3   | 2   | 2   | 2   | 3   | 2   | 2   | 2   | 2   | 2    | 2    | 3    |
| CO3 | 2   | 2   | 3   | 3   | 2   | 3   | 3   | 3   | 3   | 3    | 2    | 2    |
| CO4 | 3   | 3   | 1   | 1   | 1   | 1   | 1   | 2   | 1   | 1    | 3    | 3    |

### CO- Curriculum Enrichment Mapping

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 1             | 1                |
| CO2 | 3                 | 2             | 2                |
| CO3 | 3                 | 3             | 3                |
| CO4 | 3                 | 1             | 2                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (I Semester)**  
**MCHCC-102: ORGANIC CHEMISTRY – I**

**Objective:** The main objective of this course is to understand the difference between structure and reactivity for skill development. To understand the reagents used in organic synthesis. Also to know the stereochemistry of biphenyls, allenes and spirans to develop employability in chemical synthesis industries.

**UNIT-I** **(09 Sessions)**

**Structure and reactivity:**

Properties of organic molecules – concept of Aromaticity – Types – Huckle and Craig's rules – Benzenoid and non benzenoid compounds –annulenes –Hetero annulenes –fullerenes (C-60) – Types of organic reactions – mechanisms – Energy and Kinetic aspects –reactive intermediates – their formation and stability – Aromatic substitution reactions (electrophilic, nucleophilic and through benzyne ) – radical substitution of arynes . Nucleophilic substitution at a saturated carbon atom –SN<sup>1</sup>, SN<sup>2</sup> and SN<sup>i</sup> reactions for skill development.

**UNIT-II** **(09 Sessions)**

**Reagents in Organic Synthesis:**

NaBH<sub>4</sub>, LAH , Lithium diisopropylamide (LDA)- dicyclohexyl carbodimide (DCC), 1,3 – Dithiane (reactivity umpolung), OsO<sub>4</sub>, SeO<sub>2</sub>, Wilkinson's catalyst and 2,3 – dichloro – 5,6 – dicyano – 1,4,- benzo quinone (DDQ)

**UNIT-III** **(09 Sessions)**

**Stereochemistry:**

Conformational isomerism– cyclohexanes and decalins – optical isomerism – optical activity – molecular asymmetry and dissymmetry. Enantio and diastereo selective synthesis. Chirality – optical isomerism in biphenyls, allenes and spirans – optical isomerism in Nitrogen compounds. Geometrical isomerism – acyclic and cyclic compounds for development of skills.

**UNIT-IV** **(09 sessions)**

Pericyclic reactions and chemistry of heterocyclic compounds

Definition – classification selection rules and stereochemistry of electrocyclic reactions, cycloaddition and sigmatropic shifts, Sommelet – Hauser, Diels – Alder reaction.

Synthesis and reactivity of Indole, Pyrimidine, Pyrazine, Oxazole for employability in chemical industry.

**Course outcomes:**

Students completing this course will be able to:

CO1: Understand aromaticity and types as well as mechanisms of organic reactions

CO2: Understand how to convert one molecule into another by using oxidising and reducing reagents bringing employability globally.

CO3: Apply stereochemistry to various organic compounds and reactions

CO4: Apply knowledge of pericyclic reactions for various synthesis and conversions

**Suggested readings:**

1. Biochemistry : L. Steyer, Freeman And Co.; New York
2. Organic Synthesis: M.B. Smith: Mc Graw Hill, New York
3. Advanced Organic Chemistry Reaction, Mechanism And Structure, M.B. Smith And J. March: John Willey And Sons, New York.

4. Symmetry and Spectroscopy of Molecules, K.Veera Reddy, Newage International Pvt. Ltd, New Delhi.

**Web sources:**

- <https://www.organic-chemistry.org/>
- <https://www.organic-chemistry.org/namedreactions/>
- [https://www.internetchemistry.com/chemistry/organic\\_chemistry.htm](https://www.internetchemistry.com/chemistry/organic_chemistry.htm)

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | 3   | 3   | 2   | 3   | 2   | 3   | 2   | 2   | 3   | 2    | 3    | 2    |
| <b>CO2</b> | 3   | 1   | 3   | 3   | 2   | 2   | 3   | 2   | 3   | 2    | 3    | 3    |
| <b>CO3</b> | 3   | 1   | 2   | 3   | 3   | 1   | 2   | 1   | 1   | 1    | 3    | 2    |
| <b>CO4</b> | 3   | 1   | 2   | 3   | 1   | 2   | 1   | 2   | 3   | 2    | 2    | 3    |

**CO- Curriculum Enrichment Mapping**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|            | Skill Development | Employability | Entrepreneurship |
|------------|-------------------|---------------|------------------|
| <b>CO1</b> | 3                 | 1             | 2                |
| <b>CO2</b> | 3                 | 3             | 1                |
| <b>CO3</b> | 3                 | 2             | 2                |
| <b>CO4</b> | 3                 | 3             | 2                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (I Semester)**  
**MCHCC-103: PHYSICAL CHEMISTRY – I**

**Objectives:** This course will impart the knowledge on design and development of materials with pre-required properties for skill development and understanding of chemical processes. To give understanding the structure of solids in its influence on physical-chemical properties, also to give understanding, of phase relations chemical synthesis, reaction kinetics as well as characterization methods development of entrepreneurship and employability skills for design of the solid materials.

**UNIT-I** **(09 Sessions)**

Solid state chemistry – I

Introduction, classification, laws of crystallography, crystallographic systems, space lattice, types of lattices, Bragg's Equation, X-ray spectrometer, Rotating crystal method, Powder method, Neutron Diffraction, Heat capacities of solids, Molar heat capacities, application, quantum theories of specific heats (Einstein Equation, Debye equation) Born Haber cycle, cohesive energy Ionic crystal. Properties of solids

**UNIT-II** **(09 Sessions)**

Solid state chemistry – II

Defects in solids-point defects- linear defect- Frenkel & Schotkey defect (Mathematical derivations). Band theory of solids semiconductors – Extrinsic & Intrinsic non stoichiometric, organic semiconductors, p-n junction, rectifiers, transistors, metal purification by zone refining, preparation of single crystals of Si & Ge (Czochralski crystal pulling method) doping, Integrated circuits for development of entrepreneurship and employability skills

**UNIT-III** **(09 Sessions)**

Chemical kinetics:

zeroth order, first order, second order, third order rate equations (with suitable gaseous phase and liquid phase reaction, determination of order of reactions (method of integration, fractional life period method, differential method, isolation method) opposing reactions, Hydrogen-bromine, hydrogen- chlorine reactions, consecutive reactions photolysis of acetaldehyde. Theories of reaction rates-(collision and transition state theory). Primary and secondary salt effects, effect of dielectric constant of solvent, ion – ion interaction skill development for understanding of chemical processes mechanisms.

**UNIT-IV** **(09 Sessions)**

Thermodynamics:

Concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties and partial molar free energy, Partial molar volume and partial molar heat content and their significances. Concept of fugacity, Non ideal systems: Excess functions for non – ideal solutions. Activity, activity coefficients. Determination of activity and activity coefficients, ionic strength for skill development and the knowledge of heat and other forms of energy interact.

**Course Outcomes:**

Students completing this course will be able to:

CO1: Describe the laws of crystallography concerning to solid state structures

CO2: Describe specific crystal defects and properties of solids semiconductors

CO3: Understand rate law kinetics and theories of reaction rates for skill development bringing employability at local as well as national level

CO4: Understand of the laws of thermodynamics and their applications

### Suggested Readings

1. Text Book of Physical Chemistry by S Glasstone
2. Advanced Physical Chemistry by Gurudeep Raj
3. Modern Electrochemistry J.O.M. Bockris and A.K .M. Reddy: Plenum Press New York.
4. Physical Chemistry: Atkins, Oxford University Press, New York.
5. Physical Chemistry, I. N. Levine: Tata Mc Graw Hill Publication New Delhi.

### Web Sources

- <https://edujournal.in/physical-chemistry-handwritten-notes-download-free-notes/>
- [https://www.internetchemistry.com/chemistry/physical\\_chemistry.htm](https://www.internetchemistry.com/chemistry/physical_chemistry.htm)
- <http://www.freebookcentre.net/Chemistry/Physical-Chemistry-Books.html>

**Note: Latest edition of all the suggested readings must be used.**

### Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 2   | 3   | 2   | 2   | 3   | 2   | 2   | 2    | 3    | 1    |
| CO2 | 3   | 3   | 3   | 3   | 3   | 3   | 2   | 2   | 3   | 2    | 3    | 3    |
| CO3 | 3   | 1   | 2   | 3   | 3   | 2   | 1   | 3   | 1   | 3    | 3    | 3    |
| CO4 | 3   | 2   | 2   | 3   | 2   | 2   | 1   | 2   | 2   | 3    | 3    | 3    |

### CO- Curriculum Enrichment Mapping (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 2             | 2                |
| CO2 | 3                 | 2             | 2                |
| CO3 | 3                 | 3             | 1                |
| CO4 | 3                 | 3             | 3                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (I Semester)**  
**MCHCC-104: ANALYTICAL METHODS**

**Objectives:** Students will learn intermediate theory and laboratory techniques in analytical and physical chemistry for development of their skills. They will know the applications of electrochemistry and liquid chromatography. They will learn modern theoretical and experimental methods used to study problems of molecular structure and bonding; emphasis on spectroscopic providing employability in science & technology.

**UNIT-I** **(09 Sessions)**

Treatment of Analytical Data:

Errors in Quantitative Analysis –Standard deviation-Variance –regression analysis- statistical design of experiments and sampling. Quality control- standards of purity. Basic components of computers -comparison of micro, main frame and super computers. Synopsis of software Packages in Chemistry.

Applications for skill development in data analysis:

1. Standard deviation and variance of univariate data.
2. Roots of quadratic – equation and application to hydrogen ion concentration of strong acid.
3. Determination of rate constant of first order reaction or Beer's law using least square method (Derivation not needed).

**UNIT-II** **(09 Sessions)**

Conventional Separation Methods:

Precipitation methods- Nucleation and crystal growth- purity of precipitate-co precipitation & post precipitation – homogeneous precipitation (methods) techniques and its advantages. Use of organic reagents as precipitants. Separation by hydroxide and sulphide precipitation providing skill development in isolation and purification of compounds

**UNIT-III** **(09 sessions)**

Modern Separation Methods:

Solvent extraction- general principles – classification of extraction systems and applications to chemical analysis. Chromatography – adsorption – liquid partition – column – TLC- HPLC- GLC

Basic principles and typical applications to organic and inorganic analysis. Ion exchange methods. Cation and anion exchangers – ion exchange chromatography – Ion exchange separations. Zone Refining technique and preparation of ultrapure compounds for employability in chemical industry.

**UNIT-IV** **(09 Sessions)**

Electroanalytical Techniques:

Polarography: Introduction, Instrumentation, Ilkovic equation and its verification. Derivation of wave equation, determination of half wave potential, qualitative and quantitative applications. Amperometry: Basic principles, instrumentation, nature of titration curves, and analytical applications for employability in chemical industry.

**Course Outcomes:**

Students completing this course will be able to:

CO1: Understand the treatment of analytical data from the point of view of the "problem Solving" approach for employability in *global chemical industries*

CO2: Understand and apply the conventional separation methods such as precipitation, co-precipitation

CO3: Apply solvent extraction and chromatographic methods for separation of various local compounds

CO4: Understand the qualitative and quantitative polarographic and amperometric analysis

**Suggested Readings:**

1. Chemical Instrumentation: A. Schematic Approach, Strovel, Addison Wesley Reading Mass.
2. Analytical Chemistry by Skoog and Miller
3. A textbook of qualitative inorganic analysis by A.I. Vogel
4. Nanochemistry by Geoffrey Ozin and Andre Arsenault
5. Stereochemistry by D. Nasipuri. Organic Chemistry by Claiden.
6. Organic Analytical Chemistry: Theory And Practice: Jagmohan, Narosa Publishing House New Delhi.

**Web Sources:**

- <https://freebookcentre.net/>
- <http://www.chemguide.co.uk/>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 2   | 2   | 3   | 3   | 2   | 3   | 3   | 3   | 3   | 3    | 3    | 3    |
| CO2 | 3   | 2   | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 2    | 3    | 3    |
| CO3 | 2   | 3   | 3   | 2   | 1   | 2   | 2   | 3   | 2   | 3    | 3    | 3    |
| CO4 | 3   | 1   | 3   | 3   | 2   | 2   | 1   | 3   | 1   | 3    | 3    | 3    |

**CO- Curriculum Enrichment Mapping**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 3             | 1                |
| CO2 | 3                 | 3             | 1                |
| CO3 | 3                 | 3             | 3                |
| CO4 | 3                 | 3             | 3                |



**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (I Semester)**  
**MCHCC-151: INORGANIC CHEMISTRY PRACTICAL**

**Objectives:** Students will be able to understand the objective of their chemical experiments, properly carry out the experiments, and appropriately record and analyze the results for skill development in data analysis.

Students will be able to use standard laboratory equipment, modern instrumentation, and classical techniques to carry out experiments. Students will know and follow the proper procedures and regulations for safe handling and use of chemicals for employability and skill development.

**(20 Sessions)**

- [1] Quantitative separation of pairs of metal ions from a given mixture, copper volumetrically and nickel gravimetrically.
- [2] Separation of Fe-Mg mixture and estimation of the amount of Fe gravimetrically and Mg volumetrically from the given binary mixture solution
- [3] Separation of Cu-Zn mixture and estimate the amount of Zn gravimetrically and Cu volumetrically from the given binary mixture solution.
- [4] Determination of Zinc(II) in the given solution by EDTA method.
- [5] Preparation of tetrammine copper(II)sulphate monohydrate,  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$
- [6] Preparation of tris(thiourea)copper(I)sulphate dihydrate.
- [7] Preparation of bis[dimethylglyoximato nickel(II)].
- [8] Preparation of sodium trioxalato ferrate(III).
- [9] Preparation of cis and trans-potassium dioxalato diaqua chromate(III).
- [10] Preparation of hexamine nickel(II)chloride.

**Course outcomes:**

Students completing this course will able to:

CO1: prepare the exact solutions for quantitative analysis for skill development.

CO2: Apply the knowledge of quantitative analysis for the determination and separation of metals from ores/alloys for employability in local and national chemical industries.

CO3: synthesize inorganic complexes and also find their purity

CO4: perform gravimetrically and volumetrically separation of metal ions

**Suggested Readings:**

1. Practical Chemistry - Giri, Bajpai and Pandey, S. Chand & Co. Ltd., New Delhi.
2. Laboratory Manual in Organic Chemistry, R.K. Bansal, Willey Eastern.
3. Experimental Organic Chemistry, Vol. I and II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata Mc Graw Hill.
4. Method of Chemical Analysis G.W. Ewing Mc Graw Hill.
5. Experiments in General Chemistry, N.R. Rado And U.C. Agarwal, Eastern Press.

**Web Sources:**

- <https://www.acs.org/content/acs/en/education/students/highschool/chemistryclubs/activities/simulations.html>
- <http://www.chem.ox.ac.uk/vrchemistry/>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> | <b>PO10</b> | <b>PO11</b> | <b>PO12</b> |
|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|
| <b>CO1</b> | 2          | 2          | 3          | 3          | 2          | 2          | 3          | 1          | 2          | 3           | 3           | 3           |
| <b>CO2</b> | 3          | 3          | 3          | 3          | 3          | 3          | 1          | 3          | 2          | 1           | 3           | 3           |
| <b>CO3</b> | 3          | 2          | 3          | 3          | 3          | 2          | 2          | 2          | 2          | 3           | 3           | 2           |
| <b>CO4</b> | 3          | 2          | 3          | 3          | 2          | 1          | 1          | 2          | 3          | 3           | 3           | 2           |

**CO- Curriculum Enrichment Mapping****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | <b>Skill Development</b> | <b>Employability</b> | <b>Entrepreneurship</b> |
|------------|--------------------------|----------------------|-------------------------|
| <b>CO1</b> | 3                        | 3                    | 2                       |
| <b>CO2</b> | 3                        | 3                    | 3                       |
| <b>CO3</b> | 3                        | 3                    | 2                       |
| <b>CO4</b> | 3                        | 3                    | 1                       |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (I Semester)**  
**MCHCC-152: PHYSICAL CHEMISTRY PRACTICAL**

**Objectives:** This practical course will give scientific reasoning and quantitative analysis laboratory practice and safety practices to the post graduate students. They will learn the ability to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations and draw reasonable, accurate conclusions for skill development for chemical laboratories and industries.

**(20 Sessions)**

- [1] Conductometric titration of mixture of strong acid with sodium hydroxide.
- [2] Conductometric titration of mixture of weak acid with sodium hydroxide.
- [3] Determination of Equilibrium constant of reaction,  $KI + I_2 \rightleftharpoons KI_3$ .
- [4] Hydrolysis of an ester – A Kinetic study.
- [5] Determination of solubility product of a sparingly soluble salt by conductometric method.
- [6] Determination of heat of neutralization of an acid-base reaction.
- [7] Determination of heat of solution of a given acid-base reaction.
- [8] A study of the adsorption of oxalic acid on charcoal.
- [9] Determination of dissociation constant of acetic acid and verification of Ostwald's dilution law.
- [10] Determination of Rate constant of acid catalyzed hydrolysis of sucrose by chemical method.

**Course outcomes:**

Students completing this course will be able to:

- CO1: Analyse the solutions using conductometric titrations for employability in local and national chemical industries
- CO2: Understand mechanism of hydrolysis of an ester practically for skill development
- CO3: Evaluate heat of solution and heat of neutralization on the experimental basis
- CO4: Determine dissociation constant and rate constant of various reactions. Apply adsorption isotherm on adsorbent-adsorbate system

**Suggested Readings:**

1. Experimental physical chemistry by Frederick A. Bettelheim
2. Experimental physical chemistry by G. Peter Matthews
3. Experimental physical chemistry by Farrington Daniels
4. Experimental physical chemistry by Halpern and McBane
5. Experiments in Physical Chemistry by Shoemaker, Garland and Nible

**Web Sources**

- <https://www.labster.com/chemistry-virtual-labs/>
- <https://digitalllearning.ucf.edu/ilab/remote-labs/college-of-sciences-remote-lab-resources/>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 2   | 2   | 3   | 3   | 2   | 2   | 2   | 2   | 2   | 3    | 3    | 3    |
| CO2 | 3   | 1   | 2   | 3   | 3   | 1   | 2   | 1   | 3   | 2    | 3    | 3    |
| CO3 | 3   | 1   | 3   | 3   | 2   | 1   | 2   | 2   | 3   | 3    | 3    | 2    |
| CO4 | 3   | 2   | 1   | 3   | 2   | 2   | 3   | 2   | 1   | 3    | 3    | 1    |

**CO- Curriculum Enrichment Mapping (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 3             | 1                |
| CO2 | 3                 | 3             | 1                |
| CO3 | 3                 | 3             | 2                |
| CO4 | 3                 | 3             | 1                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (II Semester)**  
**MCHCC-201: INORGANIC CHEMISTRY – II**

**Objectives:** To make the students conversant with the nomenclature of coordination compounds. They will learn isomerism in coordination compounds, bonding theories of coordination compounds for skill development and employability in chemical industries.

**UNIT-I** **(09 Sessions)**

**Spectroscopic properties of complexes:** ground states, co-relation, Orgel Diagrams for transition metal complexes ( $d^1$ - $d^9$  states), calculations of  $Dq$ ,  $B$  &  $\beta$  parameters and charge transfer spectra in order to develop skill in complex formation.

**UNIT-II** **(09 Sessions)**

**Co-ordination chemistry of metal complexes:** Isomerism in coordination compounds, valence bond theory of complex compounds –Inner and outer orbital complexes, Introduction to Molecular orbital theory, Electro neutrality principle and back bonding, Crystal Field Theory (CFT), Crystal Field Stabilization Energy, crystal field splitting of d-orbitals in tetrahedral and square planar complexes, Nephelauxetic effect for employability in chemical industries.

**UNIT-III** **(09 Sessions)**

**Inorganic reaction mechanisms-** concept of hard and soft acids and bases, Mechanism of redox reactions-outer sphere and Inner sphere mechanisms, Octahedral and square planar substitution reaction mechanism in co-ordination compounds for skill development in understanding mechanism involved in coordination compounds.

**UNIT-IV** **(09 Sessions)**

**Mossbauer spectroscopy-** basic principles, spectral parameters- isomer shift, chemical applications of Fe (II) and Fe(III) compounds and Sn(II) and Sn(IV) compounds only, Nature of M-L bond for skill development and employability.

**Course Outcomes:**

Students completing this course will able to:

CO1: Understand spectroscopic properties of transition metal ions

CO2: Understand the effect of various ligand field strengths in the coordination complexes for skill development.

CO3: Analyze the concept of inorganic reaction mechanisms for employability skills.

CO4: Understand basic principles, spectral parameters and chemical applications of Mossbauer spectroscopy for skill development and employability at local and national level.

**Suggested Readings:**

1. Inorganic Chemistry by J. E. Huheey
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. Organic Chemistry by Morrison and Boyd
4. Concise Inorganic Chemistry by J. D. Lee
5. The Organometallic Chemistry of Transition Metals: John Willey

**Web Sources:**

- [https://chem.libretexts.org/Bookshelves/Inorganic\\_Chemistry](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry)
- [https://chem.libretexts.org/Bookshelves/Inorganic\\_Chemistry/Modules\\_and\\_Websites\\_\(Inorganic\\_Chemistry\)](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Modules_and_Websites_(Inorganic_Chemistry))

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 2   | 3   | 2   | 2   | 3   | 2   | 2   | 3    | 2    | 3    |
| CO2 | 3   | 3   | 2   | 3   | 2   | 2   | 2   | 3   | 2   | 2    | 1    | 2    |
| CO3 | 3   | 2   | 1   | 3   | 3   | 1   | 1   | 2   | 1   | 2    | 3    | 2    |
| CO4 | 3   | 2   | 3   | 3   | 2   | 3   | 2   | 2   | 3   | 3    | 2    | 1    |

**CO- Curriculum Enrichment Mapping (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 3             | 2                |
| CO2 | 3                 | 2             | 2                |
| CO3 | 3                 | 1             | 2                |
| CO4 | 3                 | 3             | 3                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (II Semester)**  
**MCHCC-202: ORGANIC CHEMISTRY – II**

**Objectives:** To impart the knowledge of the increasingly important role played by organic and transition metals reagents and catalysts with their corresponding proposed reaction mechanisms for employability in chemical industries. Knowledge for rational mechanism-based design of synthetic strategies for new and novel organic reactions will be given to students which helps in skill development and employability.

**UNIT-I** **(09 Sessions)**

Chemistry of Natural Products:

Classification, isolation, synthesis and structural elucidation of terpenoids, general methods of structure determination of citral,  $\alpha$ -terpineol, phytol and zingiberene for skill development and employability.

**UNIT-II** **(09 Sessions)**

Photochemistry:

Jablonski diagram-cis-trans isomerism, mechanisms of paterno- Buchi reaction, Norrish Type I and II reactions, Barton reaction, di- $\pi$  methane rearrangement

**UNIT-III** **(09 Sessions)**

Mechanisms of some typical name reactions:

Aldol, Perkin, Benzoin, Cannizzaro, Wittig, Reformatsky reactions. Hofmann, Curtius, Beckmann, Oppenauer Oxidation- Clemmenson, Wolf-Kishner, Meerwein-Ponndorf-Verley and Birch reductions, pinacol- pinacolone rearrangement.

**UNIT-IV** **(09 Sessions)**

Organic Spectroscopy:

Basic principles, instrumentation of UV – visible, IR and  $^1\text{H}$  &  $^{13}\text{C}$  NMR spectroscopy. Determination of structure of simple organic compounds by spectroscopic methods (like Ethyl alcohol, p-methoxy Benzyl alcohol, p-cresol, acetic acid, Cinnamic acid, Acetophenone, cyclopentanone, salicylaldehyde, Benzamide, N,N- Dimethyl aniline, 1,3,5- trimethyl benzene) for employability in industrial sector.

**Course Outcomes:**

Students completing this course will able to:

- CO1: Understand synthesis and structural elucidation of naturally occurring organic compounds for the skill development and employability at local and national level.
- CO2: Understand and apply principles involved in photo chemistry
- CO3: Understand the mechanisms of various organic reactions
- CO4: Gain the knowledge of spectroscopic analysis of various organic compounds for employability.

**Suggested Readings:**

1. Biochemistry : L. Steyer, Freeman and Co.; New York
2. Organic Synthesis: M.B. Smith: Mc Graw Hill, New York
3. Advanced Organic Chemistry Reaction, Mechanism and Structure, M.B. Smith And J. March: John Willey and Sons, New York.
4. Symmetry and Spectroscopy of Molecules, K.Veera Reddy, Newage International Pvt Ltd, New Delhi.

**Web sources:**

- <https://rmg.mit.edu/>
- <https://libguides.lib.rochester.edu/c.php?g=201104&p=4256071>
- <http://www.freebookcentre.net/Chemistry/Organic-Chemistry-Books.html>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 3   | 3   | 1   | 2   | 2   | 3   | 2   | 3    | 3    | 3    |
| CO2 | 3   | 2   | 2   | 3   | 2   | 1   | 3   | 2   | 2   | 3    | 3    | 1    |
| CO3 | 3   | 3   | 2   | 3   | 2   | 2   | 3   | 2   | 3   | 3    | 3    | 1    |
| CO4 | 3   | 3   | 3   | 3   | 1   | 3   | 2   | 3   | 1   | 3    | 3    | 3    |

**CO- Curriculum Enrichment Mapping**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 3             | 3                |
| CO2 | 3                 | 3             | 2                |
| CO3 | 3                 | 3             | 1                |
| CO4 | 3                 | 3             | 2                |



**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (II Semester)**  
**MCHCC-203: PHYSICAL CHEMISTRY – II**

**Objectives:** Objective of this course is to learn about the phenomenon of fluorescence, phosphorescence and sensitized fluorescence. They will learn fundamentals of electro chemistry, colloids and their properties and the mechanism of catalysis for the skill developments and employability.

**UNIT-I** **(10 Sessions)**

Photo Chemistry:

Consequences of light absorption –quantum yield and its determinations – fluorescence, phosphorescence and sensitized fluorescence – photolysis of aldehydes and ketones photochemical reactions between hydrogen and halogens – photosynthesis – flash photolysis for skill development.

**UNIT-II** **(08 Sessions)**

Electro Chemistry:

Interionic attraction theory of Debye and Huckle – Onsagor’s modification - determination of activity coefficients from EMF of reversible cells – concentration cells with and without transference, liquid junction potentials – applicability to hydration numbers – determination of thermodynamic data from EMF measurements – primary cells fuel cells – photo electrochemical cells to develop employability skill in electrochemical industries.

**UNIT-III** **(10 Sessions)**

Surface Chemistry & Colloids:

Adsorption of gases by solids–Langmuir, Freundlich and B.E.T theory of multi molecular adsorption–applications to heterogeneous catalysis–determination of surface area of adsorbents. Electro kinetic phenomena–Donnan membrane equilibrium – emulsions, stability of colloids, factors affecting, determination of Avogadro’s Number, origin of charge on colloidal particles–electrical double layer theory, theories of coagulation, kinetics of coagulation, size of colloidal particles-methods of measurement to employability in paint, medicinal and analytical industries.

**UNIT-IV** **(08 Sessions)**

Catalysis:

Acid – base catalysis, Michaelis–Menten catalysis, chain reactions, parallel reactions involving unimolecular steps only, oscillating reactions, auto catalysis, chemical chaos for employability in chemical industry.

**Course Outcomes:**

Students completing this course will able to:

CO1: Understand global concept of photochemistry and photolysis of aldehydes and ketones

CO2: Understand and evaluate various electrochemical parameters

CO3: Understand adsorption isotherms, electro kinetic phenomena and their applications

CO4: Understand various concepts and reactions involved in acid-base catalysis

**Suggested Readings:**

1. Text Book of Physical Chemistry by S Glasstone
2. Advanced Physical Chemistry by Gurudeep Raj
3. Modern Electrochemistry J.O.M. Bockris and A.K .M. Reddy: Plenum Press New York.
4. Physical Chemistry: Atkins, Oxford University Press, New York.
5. Physical Chemistry, I. N. Levine: Tata Mc Graw Hill Publication New Delhi.

**Web sources:**

- <http://www.freebookcentre.net/Chemistry/ElectroChemistry-Books-Download>
- <https://www.ise-online.org/books.php>
- <https://ncert.nic.in/ncerts/l/lech103.pdf>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 3   | 3   | 2   | 3   | 1   | 3   | 2   | 3    | 1    | 2    |
| CO2 | 3   | 3   | 1   | 3   | 2   | 2   | 2   | 2   | 2   | 3    | 1    | 2    |
| CO3 | 3   | 2   | 2   | 3   | 1   | 1   | 2   | 2   | 3   | 3    | 3    | 1    |
| CO4 | 3   | 1   | 2   | 3   | 3   | 1   | 3   | 3   | 1   | 3    | 2    | 3    |

**CO- Curriculum Enrichment Mapping**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 2             | 1                |
| CO2 | 3                 | 3             | 2                |
| CO3 | 3                 | 3             | 3                |
| CO4 | 3                 | 1             | 3                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (II Semester)**  
**MCHCC-204: POLYMER SCIENCE**

**Objectives:** To explain the relationship between polymer properties (thermal, rheological, mechanical), and calculation of polymer molecular weight. Students will relate polymer properties, processing and uses. The course will explain significance of polymer solubility, melting point and glass transition temperature, different types of polymerisation methods, and the importance in each of: initiation, propagation, termination, branching for the skill development and employability in polymer industries.

**UNIT-I** **(09 Sessions)**

Introduction:

Basic concepts: monomer repeat units, degree of polymerization, Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, Carother's theory addition, radical, chain-ionic and co-ordination and co- polymerization, importance of polymers for the skill development in polymer and polymerization process.

**UNIT-II** **(10 Sessions)**

Polymers (Degradation & Kinetics)

Polymer degradation – Types of degradation – thermal, mechanical, ultrasonic waves, photo-degradation, oxidative degradation (rubber and phenol-formaldehyde) and hydrolytic degradation. Kinetics of polymer reaction – addition – Free-radical, cationic and Anionic polymerization. Condensation polymerization – acid catalysed condensation reactions to enhance the employability skills.

**UNIT-III** **(10 Sessions)**

Rheological properties of polymers: -

Introduction to Rheology: Newton's and Hooks laws, rheological response of materials, the ideal fluids, non - Newtonian Fluids, time dependent fluids, power law models. Viscous flow, Relationship between stresses and strains, viscoelasticity for skill development and employability in polymer industry.

**UNIT-IV** **(08 Sessions)**

Commercial Polymers:

Polyethylene, polyvinyl chloride, polyamides, polyesters, epoxy resins and silicon polymers. Functional polymers- electrically conducting polymers. Biomedical polymers- contact lens, dental polymers, artificial heart & kidney for entrepreneurial skills & employability in polymer industry.

**Course Outcomes:**

Students completing this course will able to:

CO1: Understand different kind of globally used polymers and their properties

CO2: Understand various types of polymer degradation and their kinetics

CO3: Learn rheology properties of polymers and evaluate stress, strain or viscoelasticity in a polymer

CO4: Learn about various commercial, conducting and biopolymers

**Suggested Readings:**

1. Text Book of Polymer Science, F.W. Billmeyer, Willey Science New York.
2. Principles of Polymerization, J. Odien, John Willey, Singapore
3. Principles of Polymer Science, P. Bahadur And N. V. Shashtri , Narosa Publishing House New Delhi.
4. Polymer Sciences, V.R. Gowarikar and J. Sridhar, Willey Eastern New Delhi.

**Web Sources:**

- <https://www.wiley.com/en-us/materialssciencebooks>
- <http://www.freebookcentre.net/Chemistry/Polymer-Chemistry-Books.html>
- [https://chem.libretexts.org/Bookshelves/Organic\\_Chemistry/Supplemental\\_Modules\\_\(Organic\\_Chemistry\)/Polymers](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Polymers)

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 3   | 2   | 3   | 1   | 2   | 1   | 3   | 2   | 3    | 3    | 3    |
| CO2 | 3   | 2   | 3   | 3   | 2   | 3   | 2   | 3   | 2   | 3    | 3    | 3    |
| CO3 | 3   | 3   | 3   | 3   | 3   | 1   | 2   | 2   | 1   | 3    | 2    | 1    |
| CO4 | 3   | 2   | 3   | 3   | 3   | 3   | 2   | 3   | 1   | 3    | 3    | 3    |

**CO- Curriculum Enrichment Mapping**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 2             | 3                |
| CO2 | 3                 | 2             | 2                |
| CO3 | 3                 | 3             | 3                |
| CO4 | 3                 | 3             | 2                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (II Semester)**  
**MCHCC-251: ANALYTICAL CHEMISTRY PRACTICAL**

**Objectives:** The students will learn the basics of inorganic chemistry practical such as spectrophotometric determination of various ions. They will learn the estimation of various ions by titrimetry and spectral techniques for employability and skill development in research field.

**(20 Sessions)**

**Experiments:**

- [1] Determination of copper (II) present in a brass sample (iodometric method)
- [2] Determination of calcium hardness and magnesium hardness of hardwater sample.
- [3] Determination of chloride in a sample of water (silver nitrate method).
- [4] Estimation of copper and nickel from the given solution gravimetrically.
- [5] Determination of ferrous content in the supplied sample of iron ore by titrimetric analysis.
- [6] Determination of partition coefficient of benzene between water and benzoic acid.
- [7] Spectrophotometric verification of Beer's law.
- [8] Determination of concentration of amino acid spectrophotometrically.
- [9] Spectrophotometric determination (in ppm) of Fe(II) or Fe(III) using 1,10 phenanthroline as coloring agent.
- [10] Preparation of buffer solution of known ionic strength.

**Course outcomes:**

Students completing this course will able to:

CO1: Learn about gravimetric and titrimetric analysis of different metal ions for skill development

CO2: Determine the spectrophotometric concentration of amino acid for employability at local and national level

CO3: Prepare buffer solution of known ionic strength for skill development

CO4: Determine various metal ions in the given sample for employability in industrial sector

**Suggested Readings:**

1. Separation methods in chemical analysis by James M. Moller (Wiley Interscience 1975)

2. Introduction to separation science by Kargar, Synder and Horwath (Wiley Interscience 1975).

**Web sources:**

- <http://chemcollective.org/vlabs>
- <http://chemcollective.org/physical>
- <https://www.vlab.co.in/broad-area-chemical-sciences>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 3   | 3   | 2   | 2   | 1   | 2   | 2   | 3    | 3    | 3    |
| CO2 | 3   | 2   | 3   | 3   | 2   | 2   | 2   | 3   | 2   | 3    | 2    | 2    |
| CO3 | 3   | 1   | 3   | 1   | 2   | 3   | 2   | 3   | 1   | 3    | 2    | 2    |
| CO4 | 3   | 1   | 3   | 3   | 1   | 3   | 1   | 3   | 3   | 3    | 3    | 1    |

**CO- Curriculum Enrichment Mapping****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | <b>Skill Development</b> | <b>Employability</b> | <b>Entrepreneurship</b> |
|------------|--------------------------|----------------------|-------------------------|
| <b>CO1</b> | 3                        | 3                    | 2                       |
| <b>CO2</b> | 3                        | 3                    | 1                       |
| <b>CO3</b> | 3                        | 3                    | 2                       |
| <b>CO4</b> | 3                        | 3                    | 3                       |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) I Year (II Semester)**  
**MCHCC-252: ORGANIC CHEMISTRY PRACTICAL**

**Objectives:** Lab will provide hands-on opportunities to develop and apply this knowledge to learn the synthesis of organic compounds for skill development and employability in chemical synthesis industries.

**(20 Sessions)**

1. Synthesis and purification of following organic compounds involving one or two Stages.
  - i) Iodoform
  - ii) Picric acid
  - iii) m-dinitrobenzene
  - iv) Aspirin
  - v) Acetanilide
  - vi) p-nitroacetanilide
2. Systematic identification of about eight simple organic compounds having one or two functional groups by functional group analysis, chemical reaction and derivatisation.
3. Separation and identification of the constituents of organic compounds by the given binary organic mixture.

**Course outcomes:**

Students completing this course will able to:

CO1: Learn about the systematic identification of simple organic compounds

CO2: Separate the constituents organic compounds from the given binary organic mixture for skill development and employability

CO3: Synthesize different organic compounds for skill development and employability at local and national level

**Suggested readings:**

1. A text book of practical Organic chemistry by A.I. Vogel, ELBS and Longman group.
2. Practical Organic chemistry by Mann and Saunders, ELBS and Longman Group

**Web Sources:**

- <http://chemcollective.org/vlabs>
- <http://chemcollective.org/physical>
- <https://www.vlab.co.in/broad-area-chemical-sciences>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 3   | 3   | 2   | 3   | 2   | 3   | 2   | 3    | 2    | 1    |
| CO2 | 3   | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 2   | 3    | 3    | 3    |
| CO3 | 3   | 3   | 3   | 3   | 1   | 2   | 1   | 2   | 2   | 3    | 3    | 3    |

**CO- Curriculum Enrichment Mapping**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 3             | 2                |
| CO2 | 3                 | 3             | 3                |
| CO3 | 3                 | 3             | 2                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (III Semester)**  
**MCHCC- 301: ORGANIC SYNTHESIS -I**

**Objectives:** This course will provide an introduction to the synthesis of complex organic molecules. Transformations for C-X and C-C bond-formation, functional group reactivity, chemoselectivity, regioselectivity, and the strategy of multistep synthesis will be the core topics that are covered also including the concepts /strategy/retro synthesis stereochemistry, enolates and other carbonyl chemistry, alkene synthesis, and reduction/oxidation (introductory) etc It is important for skill development and employability in chemical synthesis and pharmaceutical industries.

**UNIT –I** **(10 Sessions)**

Molecular Rearrangements:

General mechanistic considerations– nature of migration, migratory aptitude, memory effects.

A detailed study of the following for skill development and employability in industries:

Hofmann –Martius Rearrangement, Benzidine Rearrangement, cope rearrangement, Stobbe condensation, Stevens Rearrangement, Dakin Reaction, Darzen glycidic ester condensation, , Dieckmann Reaction, Arndt eistert Synthesis, Knoevenagel Reaction, Perkin Reaction, Ullmann biaryl Reaction

**UNIT –II** **(10 Sessions)**

Heterocyclic Synthesis:

Principles of heterocyclic synthesis involving cyclization reaction and cycloaddition reaction.

Three-membered and four-membered heterocyclics- synthesis and reactions of Aziridines, Oxiranes, Thiranes, Azetidines, Oxetanes Thietanes

**UNIT –III** **(08 Sessions)**

Reduction: Introduction: Different reductive processes for skill development and employability. Hydrocarbons - alkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives, Epoxides, Nitro, Nitroso, Azo and Oxime Groups. Hydrogenolysis

**UNIT –IV** **(08 Sessions)**

Oxidation: Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and inactivated). Alcohols, diols, aldehydes, and sulphides. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetroxide, iodobenzene diacetate and Thallium (III) nitrate

**Course Outcomes:**

Students completing this course will be able to:

CO1: Predict and account for the globally encountered reaction mechanisms in organic chemistry

CO2: Choose the optimal ways and methods for the synthesis of heterocyclic compounds

CO3: Learn different reductive methods to reduce various organic compounds for skill development and employability

CO4: Identify and apply various oxidizing agents in organic reactions

**Suggested readings:**

1. Organic Synthesis: M. B. Smith: McGraw New York
2. Organometallic Reagents in Synthesis: P. R. Jenkins; Oxford Science Publishing House
3. Modern Synthetic Reaction, H. O. House; Benjamin Publishing Company, California
4. Reagents for Organic Synthesis: L. F. Fieser, Wiley Inter science New York



**Web Sources:**

- <http://www.freebookcentre.net/Chemistry/Organic-Chemistry-Books.html>
- <https://chemistrynotes.com/pages/full-course-organic-chemistry-notes>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 2   | 3   | 2   | 3   | 3   | 2   | 3   | 3    | 2    | 2    |
| CO2 | 3   | 2   | 2   | 3   | 3   | 2   | 2   | 2   | 2   | 3    | 2    | 2    |
| CO3 | 3   | 3   | 1   | 3   | 1   | 3   | 2   | 3   | 2   | 3    | 3    | 2    |
| CO4 | 3   | 2   | 3   | 3   | 1   | 3   | 2   | 3   | 3   | 3    | 3    | 3    |

**CO- Curriculum Enrichment Mapping**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 3             | 2                |
| CO2 | 3                 | 3             | 2                |
| CO3 | 3                 | 3             | 3                |
| CO4 | 3                 | 3             | 2                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (III Semester)**  
**MCHCC- 302: CHEMISTRY OF NATURAL PRODUCTS-I**

**Objectives:** This course provides a survey of natural products chemistry including biogenesis by enzyme-mediated pathways, structure determination, medicinal and biochemical significance and synthesis. Theme of this course is to recognize the chemical building blocks in nature that enable student to link structures to biosynthetic hypotheses. It Provide an overview of the field of natural product chemistry. Also discuss the use of natural products as starting materials for medicines Its applications are important for the employability in the medicinal and pharmaceutical industries

**UNIT-I** **(09 Sessions)**

Amino acids and proteins:

Introduction of amino acids, classification, general synthetic methods for the preparation of amino acids, peptide synthesis, classification of proteins, primary , secondary ,tertiary and quaternary structure of proteins

**UNIT-II** **(09 Sessions)**

Alkaloids:

Occurrence, functions, nomenclature of alkaloids, structure and synthesis of coniine, piperine, atropine, cocaine, quinine, morphine

**UNIT-III** **(09 Sessions)**

Carotinoids and plant pigments:

Introduction, classification and structure of  $\beta$ - carotene

Classification of plant pigments, structure determination of anthocyanin and flavones

**UNIT-IV** **(09 Sessions)**

Purines and pyrimidines: Constitution and synthesis of uric acid, caffeine, adenine, guanine, uracil, thymine

**Course Outcomes:**

Students completing this course will able to:

CO1: Identify, characterize and synthesize natural products such as amino acids and proteins.

CO2: Learn about the nomenclature, structure and synthesis of alkaloids.

CO3: Understand the classification and structure of  $\beta$ - carotene, anthocyanin and flavones.

CO4: Learn the constitution and synthesis of various purines and pyrimidines for employability at global level

**Suggested Readings:**

1. Chemistry of Alkaloids: S.W. Pelytier.
2. Chemistry of Natural Products: Gurudeep Raj.
3. Total Synthesis of Natural Products, K.C. Nicolaou Vol I, Vol II

**Web Sources:**

- <https://www.rsc.org/journals-books-databases/about-journals/npr/>
- <http://pubs.rsc.org/lus/natural-product-updates>
- <https://www.pdfdrive.com/chemistry-of-natural-products-books.html>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> | <b>PO10</b> | <b>PO11</b> | <b>PO12</b> |
|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|
| <b>CO1</b> | 3          | 2          | 3          | 3          | 1          | 2          | 1          | 2          | 2          | 3           | 3           | 2           |
| <b>CO2</b> | 3          | 3          | 2          | 3          | 2          | 2          | 2          | 1          | 2          | 3           | 3           | 3           |
| <b>CO3</b> | 3          | 2          | 3          | 3          | 2          | 3          | 2          | 2          | 1          | 3           | 2           | 2           |
| <b>CO4</b> | 3          | 3          | 2          | 3          | 1          | 1          | 3          | 1          | 3          | 3           | 2           | 3           |

**CO- Curriculum Enrichment Mapping****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | <b>Skill Development</b> | <b>Employability</b> | <b>Entrepreneurship</b> |
|------------|--------------------------|----------------------|-------------------------|
| <b>CO1</b> | 3                        | 1                    | 2                       |
| <b>CO2</b> | 3                        | 3                    | 3                       |
| <b>CO3</b> | 3                        | 3                    | 2                       |
| <b>CO4</b> | 3                        | 3                    | 2                       |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (III Semester)**  
**MCHCC- 303: HETEROCYCLIC CHEMISTRY**

**Objectives:** The main goal is to design and develop chemical transformations that facilitate rapid synthesis of heterocyclic compounds with economic, eco-friendly with desired properties and excellent yield for skill development. Due to main importance in biology, heterocyclic compounds find wide applications in diverse areas such as in dyes, photosensitizers, coordination compounds, polymeric materials and many more to mention. Purines as the main part of biological systems, can be explored as key factors for transformations and learn skills for the employability in synthesis industries.

**UNIT- I** **(09 Sessions)**

Nomenclature of Heterocyclic compounds:

Classification, Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocyclic. Importance of heterocyclic compounds, applications of heterocycles in medicines for the skill development in naming the heterocyclic compounds.

**UNIT –II** **(09 Sessions)**

Synthesis of ring fluorinated heterocycles, electrophilic fluorination, Balz-Schiemann reaction, Halex reaction, isotopically labeled heterocycles, bioprocess in heterocyclic chemistry for employability in synthesis of compounds.

**UNIT –III** **(09 Sessions)**

Six- Membered Heterocyclic compounds with One Heteroatom-

Synthesis and reaction of pyrylium salts and pyrones, Synthesis and reaction of and benzopyrylium salts, coumarin and chromones

**UNIT- IV** **(09 Sessions)**

Purines: Reaction and synthesis, reaction with electrophilic reagents, reaction with radicals, oxidizing agents, reducing reagents, reaction with nucleophilic reagents, direct ring C-metallation, metal halogen exchange, oxy and amino purines, purines carboxylic acids, ring synthesis of purines for employability in chemical industries.

**Course outcomes:**

Students completing this course will able to:

CO1: Understand the basic concepts and different methods of nomenclature of heterocyclic compounds for skill development *at local level*

CO2: Understand methods for preparation and properties of ring fluorinated heterocycles

CO3: Learn particular properties and reactions of pyrylium salts and pyrones

CO4: Demonstrate an understanding of synthetic methods and properties of purines

**Suggested Readings:**

1. Heterocyclic Chemistry, T.L. Gillchrist: Addison Wesley, Ltd England.
2. Heterocyclic Chemistry Synthesis Reaction and Mechanism, R.K. Bansal, Newage International Publisher, New Delhi.
3. Hetrocylic Chemistry, Vol I, II, III, R. Gupta, Springer Verler Berlin.
4. Aromatic Heterocyclic Chemistry David. T. Davies, Oxford University Press.

**Web Sources:**

- <https://www.wiley.com/en-us/materialssciencebooks>

- <http://www.freebookcentre.net/Chemistry/Polymer-Chemistry-Books.html>
- [https://chem.libretexts.org/Bookshelves/Organic\\_Chemistry/Supplemental\\_Modules\\_\(Organic\\_Chemistry\)/Polymers](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Polymers)

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | 3   | 2   | 2   | 3   | 3   | 2   | 3   | 2   | 2   | 3    | 2    | 2    |
| <b>CO2</b> | 3   | 1   | 2   | 3   | 2   | 2   | 3   | 1   | 3   | 3    | 2    | 3    |
| <b>CO3</b> | 3   | 2   | 3   | 3   | 1   | 1   | 2   | 3   | 3   | 3    | 1    | 2    |
| <b>CO4</b> | 3   | 1   | 1   | 3   | 2   | 2   | 2   | 2   | 1   | 3    | 1    | 3    |

**CO- Curriculum Enrichment Mapping (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | Skill Development | Employability | Entrepreneurship |
|------------|-------------------|---------------|------------------|
| <b>CO1</b> | 3                 | 3             | 2                |
| <b>CO2</b> | 3                 | 3             | 2                |
| <b>CO3</b> | 3                 | 2             | 1                |
| <b>CO4</b> | 3                 | 2             | 3                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (III Semester)**  
**MCHDE-304: INSTRUMENTAL METHODS IN CHEMICAL ANALYSIS**  
**Departmental Elective-I**

**Objectives:** To impart the knowledge about radio analytical methods of analysis and their principles and applications for skill development. Students will know about thermal methods of analysis like TGA, DTA and DSC. They will understand about structure identification, topology, morphology, composition and crystallographic information by using XRD and SEM for skill developments and employability in chemical analysis industries.

**UNIT – I** **(10 Sessions)**

Radioactive methods:

Nuclear reactions and radiation, radioactive decay measurements, ionization chamber, proportional counter, Geiger-Muller counter, scintillation counter, semi-conductor detectors, pulse height discrimination counting equipments, activation analysis application of radio nuclides to provide employability in nuclear laboratories.

**UNIT – II** **(10 Sessions)**

Thermal and Calorimetric methods of analysis:

Thermo gravimetric analysis, apparatus, methodology, application, differential thermal analysis, apparatus, methodology, differential scanning calorimetry, instrumentation, methodology. Comparative study of TGA and DTA. Thermometric titrimetry and applications to acid-base and complexometric titrations to provide employability in instrumentation laboratories.

**UNIT – III** **(08 Sessions)**

X-ray Methods:

Production of x-rays, x-ray spectra, absorption methods of x-ray, determination of molecular structure by X-ray diffraction, crystal morphology, lattice and unit cells, kinds, space lattice, planes or faces of cubic systems, labeling the planes, the Miller indices for skill development to know the morphology of compounds.

**UNIT-IV** **(08 Sessions)**

Scanning Electron Microscopy: Basic Concepts, Instrumentation and its applications

**Course outcomes:**

Students completing this course will able to:

- CO1: Understand various radio analytical methods of analysis, their principles and applications for employability & skill development.
- CO2: Develop the ability to analyze samples using different thermal and calorimetric methods of analysis
- CO3: Apply X-ray spectroscopy for determination of lattice structure of any molecule
- CO4: Analyze topography, morphology, composition and size of the sample using scanning electron microscopy for employability at national as well as global level

**Suggested Readings:**

1. Analytical Chemistry, G.D. Christian, J. Wiley.
2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J. Holler, W.B. Saunders.
3. Analytical Chemistry-Principles, J.H. Kennedy, W.B. Saunders.
4. Analytical Chemistry-Principles and Techniques, L.G. Hargis, Prentice Hall.
5. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, W.B. Saunders.
6. Principles of Instrumental Analysis, D.A. Skoog, W.B. Saunders.
7. Quantitative Analysis, R.A. Day, Jr. and A. L. Underwood, Prentice Hall.
8. Environmental Solution Analysis, S. M. Khopkar, Wiley Eastern.
9. Basic Concepts of Analytical Chemistry, S. M. Khopkar, Wiley Eastern.
10. Handbook of Instrumental Techniques for Analytical Chemistry, F. Settle, Prentice Hall.

**Web Sources:**

- <https://www.wiley.com/en-us/materialssciencebooks>
- <http://www.freebookcentre.net/Chemistry/Polymer-Chemistry-Books.html>
- [https://chem.libretexts.org/Bookshelves/Organic\\_Chemistry/Supplemental\\_Modules\\_\(Organic\\_Chemistry\)/Polymers](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Polymers)

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | 3   | 2   | 3   | 3   | 3   | 3   | 2   | 3   | 2   | 3    | 3    | 3    |
| <b>CO2</b> | 3   | 2   | 3   | 3   | 2   | 3   | 2   | 3   | 3   | 3    | 3    | 2    |
| <b>CO3</b> | 3   | 1   | 3   | 3   | 2   | 3   | 1   | 2   | 1   | 3    | 2    | 3    |
| <b>CO4</b> | 3   | 3   | 3   | 3   | 1   | 2   | 3   | 2   | 2   | 3    | 2    | 2    |

**CO- Curriculum Enrichment Mapping**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | Skill Development | Employability | Entrepreneurship |
|------------|-------------------|---------------|------------------|
| <b>CO1</b> | 3                 | 3             | 2                |
| <b>CO2</b> | 3                 | 3             | 2                |
| <b>CO3</b> | 3                 | 3             | 2                |
| <b>CO4</b> | 3                 | 3             | 3                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (III Semester)**  
**MCHDE-304(A) GREEN CHEMISTRY**  
**Departmental Elective-I**

**Objectives:** The primary objective of this course is to make students aware of how chemical processes can be designed, developed and run in a sustainable way. Student will acquire the competence to think of chemistry as a sustainable activity for development of skills. To give information about the design competitive chemical products and processes that attain the highest level of the pollution-prevention hierarchy by reducing pollution at its source for the employability skill in green chemical industries.

**Unit – I** **(09 Sessions)**

Introduction to Green Chemistry

Introduction to green chemistry need for green chemistry. Goals of green chemistry. Limitations/ obstacles in the pursuit of the goals of green chemistry

**Unit – II** **(09 Sessions)**

**Principles of Green Chemistry**

Principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis; Prevention of Waste/ byproducts/ toxic products; maximum incorporation of the materials used in the process into the final products (Atom Economy) for skill development for discriminating the hazardous and nonhazardous chemical products.

**Unit –III** **(09 Sessions)**

Designing a Chemical synthesis

Designing safer chemicals—different basic approaches to do so; selection of appropriate auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids; energy requirements for reactions; selection of starting materials; designing of biodegradable products.

Green Synthesis of the following compounds: adipic acid, catechol, methyl methacrylate, urethane, benzyl bromide, citral, ibuprofen, paracetamol, furfural importance of green chemistry for better skill development and employability in chemical industry.

**Unit – IV** **(09 Sessions)**

Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; Green chemistry in sustainable development, Use of microwaves in green chemistry role of green chemistry for employability in industries.

**Course Outcomes:**

Students completing this course will able to:

CO1: Learn the basic principles and goals of green and sustainable chemistry for skill development

CO2: Understand principles of Green Chemistry and relate them to green process metrics for application at local level

CO3: Learn alternative solvent media and energy sources for chemical processes

CO4: Review the trends in Green Chemistry and learn about oxidation reagents and catalysts



**Suggested Readings:**

1. V. K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).
2. P. T. Anastas & J.K. Warner: Oxford Green Chemistry- Theory and Practical, University Press
3. A. S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001).
4. M. C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
5. M. A. Ryan & M. Tinnes and, Introduction to Green Chemistry, American Chemical Society, Washington (2002).
6. Green Chemistry Theory and Practice. P. T. Anatas and J.C. Warner
7. Real world cases in Green Chemistry M. C. Cann and M.E. Connolly
8. Green Chemistry: Introductory Text M. Lancaster: Royal Society of Chemistry (London)
9. Green Chemistry: Introductory Text, M. Lancaster
10. Principles and practice of heterogeneous catalysis, Thomas J. M., Thomas M.J., John Wiley

**Web Sources:**

- <https://www.internetchemistry.com/chemistry/green-chemistry.php>
- <https://www.asdlib.org/onlineArticles/courseware/Manahan/GreenChem-2.pdf>
- <https://ncert.nic.in/ncerts/l/kech207.pdf>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | 3   | 3   | 1   | 3   | 1   | 3   | 2   | 3   | 2   | 3    | 2    | 3    |
| <b>CO2</b> | 3   | 2   | 3   | 3   | 2   | 3   | 3   | 3   | 2   | 3    | 3    | 3    |
| <b>CO3</b> | 3   | 3   | 3   | 3   | 3   | 2   | 2   | 2   | 3   | 3    | 2    | 2    |
| <b>CO4</b> | 3   | 2   | 3   | 3   | 1   | 2   | 2   | 1   | 2   | 3    | 3    | 3    |

**CO- Curriculum Enrichment Mapping**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | Skill Development | Employability | Entrepreneurship |
|------------|-------------------|---------------|------------------|
| <b>CO1</b> | 3                 | 2             | 1                |
| <b>CO2</b> | 3                 | 2             | 2                |
| <b>CO3</b> | 3                 | 3             | 3                |
| <b>CO4</b> | 3                 | 3             | 2                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (III Semester)**  
**MCHDE-304(B): FUEL CHEMISTRY**

**Departmental Elective-I**

**Objectives:** The main objective is to provide a basic scientific and technical understanding of fuel. Handling of hydrocarbon fuels and lubricants for skill development. Students will learn the emerging alternative & renewable fuels. This will enable students to be industry ready to contribute effectively in the field of petroleum chemistry and technology to inculcate skills and employability in petrochemical industries.

**Unit-I** **(09 Sessions)**

Energy sources

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value for skill development.

**Unit-II** **(09 Sessions)**

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas-composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining

**Unit-III** **(09 Sessions)**

Petroleum and Petrochemicals: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels for employability in petroleum-based industry.

**Unit-IV** **(09 Sessions)**

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pour point) and their determination for entrepreneurship and employability in petroleum-based industry.

**Course Outcomes:**

Students completing this course will be able to:

CO1: Learn about the various fuels and their classification for skill development

CO2: Understand the various industrial applications of coal

CO3: Learn the chemistry of petroleum fuel technology and its applications for employability at national and global level

CO4: Understand the classification, properties refining processes for lubricants

**Suggested Readings:**

1. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
2. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
3. B. K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.

**Web sources:**

- <https://onlinelibrary.wiley.com/doi/book/10.1002/9781118796214>
- <http://www.freebookcentre.net/Chemistry/Chemistry-Books-Online.html>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 2   | 3   | 3   | 3   | 2   | 2   | 2   | 3    | 2    | 2    |
| CO2 | 3   | 3   | 3   | 3   | 2   | 3   | 1   | 3   | 1   | 3    | 3    | 3    |
| CO3 | 3   | 2   | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 3    | 2    | 3    |
| CO4 | 3   | 2   | 3   | 3   | 2   | 2   | 3   | 2   | 3   | 3    | 3    | 2    |

**CO- Curriculum Enrichment Mapping**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 2             | 2                |
| CO2 | 3                 | 3             | 2                |
| CO3 | 3                 | 3             | 2                |
| CO4 | 3                 | 3             | 3                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (III Semester)**  
**MCHCC-351: ORGANIC CHEMISTRY PRACTICAL-I**

**Objectives:** To learn the quantitative analysis of elements like sulphur in the given organic compound. Students will know the method of synthesis of various name reactions of industrial application for development of skills to provide employability in chemical synthesis industries.

**(20 Sessions)**

- 1) Quantitative Analysis  
Estimation of element:  
Estimation of sulphur in an organic compound by Messenger's Method.
- 2) Organic Synthesis:
  - i) Beckmann Rearrangement-  
Preparation of benzilide from benzophenone oxime.
  - ii) Benzilic Acid Rearrangement-  
Preparation of benzilic acid from benzil.
  - iii) Benzoin condensation-  
Preparation of benzoin from benzal chloride.
  - iv) Cannizzaro's reaction-  
Preparation of benzyl alcohol and benzoic acid together from benzaldehyde.
  - v) Claisen Schmidt reaction-  
Preparation of dibenzal acetone from benzaldehyde.
  - vi) Clemmensen reaction-  
Preparation of 2,4-dihydroxy ethyl benzene from 2,4-dihydroxy acetophenone.
  - vii) Reformatsky reaction-  
Preparation of  $\beta, \beta'$  diphenyl propionate from benzophenone. role of naming reaction for employability in chemical synthesis industries.
3. Extraction of Organic Compounds from Natural Sources
  - i). Isolation of caffeine from tea leaves.
  - ii). Isolation of casein from milk (the students are required to try some typical colour reaction of protein.
  - iii). Isolation of lactose from milk (purity of sugar should be checked and Rf value reported).
  - iv). Isolation of nicotine dipicrate from tobacco.
  - v). Isolation of cinchonine from cinchona bark.
4. Paper Chromatography:  
Separation and identification of the sugar present in the given mixture of glucose, fructose and sucrose by paper chromatography.
5. Viva voce
6. Record

**Course outcomes:**

Students completing this course will able to:

CO1: Demonstrate mastery of basic organic chemistry laboratory techniques, including distillation, recrystallization, melting point determination, liquid-liquid extraction, gravity and liquid filtration, and chromatography for employability in local and national industries

CO2: Demonstrate the ability to safely and effectively perform synthetic organic reactions, using proper glassware set-up, handling of hazardous chemicals, and following the prescribed experimental procedures

**Suggested Readings:**

1. Separation methods in chemical analysis by James M. Moller (Wiley Interscience 1975)
2. Introduction to separation science By Kargar, Synder and Horwath (Wiley Interscience 1975).

**Web sources:**

- <http://chemcollective.org/vlabs>
- <http://chemcollective.org/physical>
- <https://www.vlab.co.in/broad-area-chemical-sciences>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 3   | 3   | 2   | 3   | 1   | 2   | 1   | 3    | 3    | 3    |
| CO2 | 3   | 2   | 3   | 3   | 1   | 3   | 2   | 3   | 2   | 3    | 3    | 3    |

**CO- Curriculum Enrichment Mapping**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 3             | 2                |
| CO2 | 3                 | 3             | 2                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (IV Semester)**  
**MCHCC-401: ORGANIC SYNTHESIS –II**

**Objectives:** To provide an introduction to the synthesis of complex organic molecules. Transformations for C-X and C-C bond-formation, functional group reactivity, chemoselectivity, regioselectivity, and the strategy of multistep synthesis will be the core topics that are covered for skill development and employability in organic chemical synthesis laboratories and industries.

**UNIT -I** **(09 Sessions)**

Basic concept of disconnections, types of synthesis, types of transforms, polarity and retro-synthetic analysis for skill development.

**UNIT- II** **(09 Sessions)**

Carbon – halogen (C-X) Disconnection:

Strategy of C-X Disconnection, one group C-X Disconnection, two group C-X Disconnection, synthesis of amines by using C-X Disconnection, useful chemical reactions using C-X Disconnection

**UNIT –III** **(09 Sessions)**

Carbon – carbon (C-C) Disconnection:

Useful chemical reactions using C-C Disconnection, one group and  $\alpha$ - carbonyl C-C Disconnection, generation of enolates, chemo selectivity, region-selectivity, stereo selectivity and kinetics of enolate formation, chemical reactions of enolates

**UNIT –IV** **(09 Sessions)**

Protecting groups in organic synthesis:

Protecting strategy, Protecting Groups -Principle of protection of carbonyl and carboxyl alcoholic and amino groups and their importance for employability in industrial sector.

**Course Outcomes:**

Students completing this course will able to:

- CO1: Understand basic concept of disconnection and retro-synthetic analysis for skill development
- CO2: Apply carbon – halogen (C-X) Disconnection in various organic reactions
- CO3: Perform carbon – carbon (C-C) Disconnection and evaluate kinetics of enolate formation
- CO4: Understand the application of protecting groups to synthesize the specific product *for employability in local and national industries*

**Suggested Readings:**

1. Designing Organic Synthesis, S. Warren, Wiley.
2. Organic Synthesis-Concept, Methods and Starting Materials, J.Fuhrhop and G.Penzilin, Verlage Vch.
3. Some Modern Methods of Organic Synthesis. W. Carruthers, Cambridge Univ. Press.

4. Modern Synthetic Reactions, H.O. House, W.A. Benjamin,
5. Advanced Organic Chemistry: Reactions, Mechanisms And Structure, J. March, Wiley.
6. Principles of Organic Synthesis, R.Norman and J.M.Coxon, Blackie Academic & Professional.
7. Advanced Organic Chemistry Part B, F.A. Carey and R.J.Sundberg, Plenum Press.
8. Medicinal Chemistry, A. Burger, 3<sup>rd</sup> Edn., Wiley, 1970.
9. Chemistry of Pesticides, N.M. Melnikov, Residue Reviews, Vol.36, Springer Verlag, New York.
10. Future for Insecticides, R.C. Netealr, J. J. Mckalvery, Jr. John Wiley & Sons, New York,
11. Pesticide Processes Encyclopedia, Marshal Sitting Hoyes Data Corporation, U.S.A., 1977.

**Web Sources:**

- <http://www.freebookcentre.net/Chemistry/Organic-Chemistry-Books.html>
- <https://chemistrynotes.com/pages/full-course-organic-chemistry-notes>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | 3   | 1   | 2   | 3   | 1   | 3   | 1   | 2   | 1   | 3    | 3    | 2    |
| <b>CO2</b> | 3   | 2   | 3   | 3   | 3   | 3   | 2   | 3   | 2   | 3    | 2    | 3    |
| <b>CO3</b> | 3   | 2   | 3   | 3   | 3   | 3   | 2   | 3   | 2   | 3    | 2    | 3    |
| <b>CO4</b> | 3   | 1   | 2   | 3   | 2   | 1   | 1   | 2   | 2   | 3    | 1    | 3    |

**CO- Curriculum Enrichment Mapping**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | Skill Development | Employability | Entrepreneurship |
|------------|-------------------|---------------|------------------|
| <b>CO1</b> | 3                 | 2             | 2                |
| <b>CO2</b> | 3                 | 3             | 3                |
| <b>CO3</b> | 3                 | 3             | 3                |
| <b>CO4</b> | 3                 | 2             | 1                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (IV Semester)**  
**MCHCC-402: CHEMISTRY OF NATURAL PRODUCTS-II**

**Objectives:** To learn about the molecular structure present in different types of vitamins. Students will know about the chemistry of lipids, constitution of steroids and their physiological importance and the chemistry behind the genetic materials like DNA and RNA for skill development and employability in the drug industries.

**UNIT-I** **(09 Sessions)**

Chemistry and biochemical action of vitamins for skill development:

Occurrence, biological functions, constitution and synthesis of-  
(Vitamin A), Thiamin (Vitamin B1), Riboflavin (Vitamin B2), Nicotinamide (Vitamin B5),  
Cynocobalamine (Vitamin B12), Ascorbic Acid (Vitamin C), Tocopherols (Vitamin E)

**UNIT-II** **(09 Sessions)**

Lipids:

Occurrence, biological functions, classification, analysis of fats and oils, chemical properties of fats, rancidity, brief idea about phospholipids, glycolipids, derived lipids, waxes

**UNIT-III** **(09 Sessions)**

Steroids:

Introduction, nomenclature of steroids, stereochemistry and absolute configuration of steroids, constitution and synthesis of cholesterol, ergosterol, stigmasterol, brief idea about steroidal hormones

**UNIT-IV** **(09 Sessions)**

Nucleic acids:

Introduction, classification, relation among nucleic acids, nucleotides and nucleosides, isolation of nucleic acids, components of nucleic acid, structure of nucleosides, structure of RNA and DNA

**Course Outcomes:**

Students completing this course will able to:

- CO1: Understand occurrence, biological functions, constitution and synthesis of vitamins for skill development
- CO2: Learn occurrence, biological functions, classification, properties and analysis of Lipids
- CO3: Understand nomenclature, stereochemistry and synthesis of different steroids
- CO4: Understand classification, structure and isolation of nucleic acids for employability in local and national pharmaceutical industries

**Suggested Readings:**

1. Natural Products: Chemistry and Biological Significance, J.Mann. R.S.Davidson, J.B.Hobbs, D.V. Banthrope and J. B. Harborne. Longman, Essex.
2. Organic Chemistry, Vol 2, I.L. Finar, EIBS
3. Stereo selective Synthesis: A Practical Approach, M. Nogradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed.S. Coffey, Elsevier.



5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed.Kurt Hostettmann. M. P. Gupta and A. Marston. Harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm, Harwood Academic Publishers
7. Synthetic Organic Chemistry, O.P. Agarwal, 10<sup>th</sup> edition, Publishing House, Meerut, 1994.

**Web Sources:**

- <https://www.rsc.org/journals-books-databases/about-journals/npr/>
- <http://pubs.rsc.org/lus/natural-product-updates>
- <https://www.pdfdrive.com/chemistry-of-natural-products-books.html>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 2   | 3   | 2   | 3   | 2   | 1   | 1   | 3    | 3    | 3    |
| CO2 | 3   | 2   | 3   | 3   | 2   | 1   | 2   | 1   | 3   | 3    | 3    | 3    |
| CO3 | 3   | 2   | 3   | 3   | 1   | 1   | 1   | 3   | 2   | 3    | 3    | 3    |
| CO4 | 3   | 2   | 2   | 3   | 2   | 3   | 2   | 3   | 2   | 3    | 1    | 2    |

**CO- Curriculum Enrichment Mapping**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 1             | 1                |
| CO2 | 3                 | 2             | 1                |
| CO3 | 3                 | 3             | 3                |
| CO4 | 3                 | 2             | 2                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (IV Semester)**  
**MCHCC- 403: APPLICATIONS OF SPECTROSCOPY IN ORGANIC CHEMISTRY**

**Objectives:** To know about various electronic transitions occurs in ultra violet spectroscopy. Students will learn about methods of analysis of functional groups in IR spectroscopy, about structure identification by NMR spectroscopy and mass spectra of different organic compounds for employability and skill developments in research and chemical industries.

**UNIT –I** **(09 Sessions)**

Ultraviolet and Visible Spectroscopy for employability and skill development:

Various electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls

**UNIT- II** **(09 Sessions)**

Infra-Red Spectroscopy:

Instrumentation and sample handling for skill development. Characteristic vibration frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibration frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi Resonance for employability.

**UNIT –III** **(09 Sessions)**

Nuclear Magnetic Resonance Spectroscopy:

General introduction and definition, chemical shift, spin-spin interaction, shielding & deshielding effects, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), complex spin-spin interaction between two, three, four and five nuclei (first order spectra), vicinal coupling, contact shift reagents, solvent effects. Fourier transform technique, nuclear Overhauser effect (NOE), 2D-NMR spectroscopy-COSY, NOESY techniques for employability and skill development

**UNIT –IV** **(09 Sessions)**

Mass Spectroscopy

Introduction, ion production, factors affecting fragmentation, ion analysis, ion abundance, Mass spectral fragmentation of organic compounds, common functional groups, and molecular ion peaks

**Course Outcomes:**

Students completing this course will able to:

CO1: Understand various concepts of UV spectroscopy and its application to conjugated dienes and carbonyl compounds for skill development

CO2: Learn about the instrumentation, analysis and application of IR spectroscopy to organic compounds for employability

CO3: Analyze and identify organic compounds on the basis of NMR spectroscopy for employability in local and national industries

CO4: Understand the importance of mass spectra in structure determination of organic compounds

#### Suggested Readings:

1. Modern Spectroscopy, J. M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windalwl and F. L. Ho. Wiley Interscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R. V. Parish, Ellis Harwood.;
4. Physical Methods in Chemistry, R. S. Drago, Saunders College.
5. Chemical Applications of Group Theory, F. A. Cotton.
6. Introduction to Molecular Spectroscopy, G.M. Barrow. McGraw Hill.
7. Basic principles of spectroscopy, R. Chang. McGraw Hill.
8. Theory and Applications of UV Spectroscopy, H. H. Jaffe and M. Orchin, IBH-Oxford.
9. Introduction to Photoelectron Spectroscopy, P. K. Ghosh, John Wiley.
10. Introduction to Magnetic Resonance, A. Carrington and A. D. Maclachalan, Harper & Row

#### Web Sources:

- <https://www.wiley.com/en-us/materialssciencebooks>
- <http://www.freebookcentre.net/Chemistry/Polymer-Chemistry-Books.html>
- [https://chem.libretexts.org/Bookshelves/Organic\\_Chemistry/Supplemental\\_Modules\\_\(Organic\\_Chemistry\)/Polymers](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Polymers)

**Note: Latest edition of all the suggested readings must be used.**

#### Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs) (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 3   | 3   | 2   | 3   | 3   | 3   | 2   | 3    | 3    | 3    |
| CO2 | 3   | 2   | 3   | 3   | 2   | 2   | 2   | 3   | 2   | 3    | 3    | 3    |
| CO3 | 3   | 2   | 3   | 3   | 2   | 2   | 2   | 3   | 2   | 3    | 3    | 3    |
| CO4 | 3   | 2   | 3   | 3   | 2   | 3   | 2   | 2   | 2   | 3    | 3    | 3    |

#### CO- Curriculum Enrichment Mapping

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 3             | 2                |
| CO2 | 3                 | 3             | 3                |
| CO3 | 3                 | 3             | 3                |
| CO4 | 3                 | 3             | 2                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (IV Semester)**  
**Departmental Elective-II**  
**MCHDE-404: MEDICINAL CHEMISTRY**

**Objectives:** This course provides an introduction to the chemical principles behind the design and production of pharmaceutical agents. Focus is on explaining and predicting how small organic molecules bind to biological receptors, inhibit enzymes and get metabolized. This course draws on and expands upon material covered in introductory organic chemistry such as proposing reasonable arrow-pushing mechanisms for organic reactions and predicting the reactivity of organic molecules with particular reagents for entrepreneurial skill and employability in drug discovery.

**UNIT-I**

**(10 Sessions)**

Characteristics of Synthetic Drugs: Relationship between chemical structure and biological activity (SAR). Assay of drugs: chemical assay, biological assay, immunological assay, absorption of drugs, isosterism.

Receptor Site Theory, Approaches to drug design. Introduction to combinatorial synthesis in drug discovery for employability in pharmaceutical industries.

**UNIT-II**

**(08 Sessions)**

Antibiotics, Antiviral and antibacterials: introduction, pharmacodynamics, anti-viral strategy  
Synthesis of following for skill development and employability-

Broad spectrum antibiotics - Norfloxacin, Ciprofloxacin

Antibiotic  $\beta$ -Lactam type - Cephalosporins, Penicillins

Antineoplastic drugs –Classification, alkylating agents (busulphan, mefalan), antimetabolites (methotrxate, mercaptopurine, flurouracil), natural products (vinibastine, vinicristine)

Antifungal – polyenes

Antiviral – Acyclovir

**UNIT-III**

**(08 Sessions)**

Antimalarials: Chloroquine, Chloroguanide and Mefloquine, Atovaquone, Primaquine, Artemisinin and derivatives, Halofantrine antimalarial drug combination therapy

**UNIT-IV**

**(08 Sessions)**

a.) Non-steroidal Anti-inflammatory Drugs (NSAIDs) : introduction, mechanism of action, classification, synthesis and action for employability and skill development

b.) Diclofenac Sodium, Ibuprofen and Nefopam

Antihistaminic and antiasthmatic agents: Terfenadine, Cinnarizine, Salbutamol

**Course outcomes:**

Students completing this course will able to:

CO1: Understand chemical principles behind design and production of pharmaceutical agents for skill development

CO2: Gain knowledge applications of antibiotics, antiviral and antibacterials compounds

CO3: Understand about the synthesis and applications of antimalarial compounds for skill development and employability

CO4: Learn about the classification, mechanism of action and synthesis of NSAIDs for employability in local, national and global pharmaceutical sector

**Suggested Readings:**

1. A. Burger, Medicinal Chemistry, Vol. I-III, (1995) Wiley Interscience Publications, New York.
2. W. O. Foye, Principles of Medicinal Chemistry, 3<sup>rd</sup> Edition (1989), Lea & Febiger/ Varghese Publishing House, Bombay.
3. D. Lednicer and L. A. Mitscher, The Organic Chemistry of Drug Synthesis, Vol. I-III, Wiley Interscience.
4. A. Kar, Medicinal Chemistry, (1993) Wiley Eastern Ltd., New Delhi.
5. N. K. Terrett, Combinatorial Chemistry, (1998) Oxford Univ. Press, Oxford.
6. O.P. Agarwal, Synthetic Organic Chemistry, Goel Publication House, Meerut.

**Web Sources:**

- <https://www.wiley.com/en-us/materialssciencebooks>
- <http://www.freebookcentre.net/Chemistry/Polymer-Chemistry-Books.html>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | 3   | 2   | 3   | 3   | 3   | 1   | 1   | 3   | 1   | 3    | 3    | 3    |
| <b>CO2</b> | 3   | 2   | 3   | 3   | 2   | 2   | 2   | 3   | 3   | 3    | 3    | 2    |
| <b>CO3</b> | 3   | 2   | 3   | 3   | 2   | 2   | 2   | 3   | 3   | 3    | 2    | 2    |
| <b>CO4</b> | 3   | 2   | 3   | 3   | 2   | 3   | 1   | 2   | 2   | 3    | 3    | 3    |

**CO- Curriculum Enrichment Mapping**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|            | Skill Development | Employability | Entrepreneurship |
|------------|-------------------|---------------|------------------|
| <b>CO1</b> | 3                 | 2             | 2                |
| <b>CO2</b> | 3                 | 3             | 3                |
| <b>CO3</b> | 3                 | 3             | 3                |
| <b>CO4</b> | 3                 | 3             | 2                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (IV Semester)**  
**MCHDE-404(A): PHARMACEUTICAL CHEMISTRY**  
**Departmental Elective-II**

**Objectives:** A main objective of this course is to understand the fundamentals pharmaceutical organic chemistry. To know the reactions of functional groups with mechanism to convert organic molecule as medicine to develop the professional skills of a chemist. Understanding of the basics of stereochemistry of different drugs and their physiological effects. Also to learn the applications of reagents in organic synthesis of drugs. To learn the therapeutic uses of organic compounds as drug to provide employability skills in pharmaceutical industries and drug discoveries.

**Unit –I** **(09 Sessions)**  
Drugs & Pharmaceuticals: Drug discovery, design and development for employability; Basic Retro synthetic approach. Physiochemical properties of drugs (carboxylic acids and phenols)

**Unit –II** **(09 Sessions)**  
Non-steroidal Anti-inflammatory Drugs (NSAIDs):  
Synthesis of the representative drugs of the following classes for employability: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, Ibuprofen)

**Unit-III** **(09 Sessions)**  
Antibiotics, Antiviral, antibacterials and anti-fungal drugs:  
antibiotics (Chloramphenicol),  
Antiviral – Acyclovir  
Antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim)

**Unit-IV** **(09 Sessions)**  
Fermentation:  
Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B<sub>2</sub> and Vitamin C for employability and skill development

**Course outcomes:**

Students completing this course will able to:

- CO1: Understand the concept of drug discovery, design and development for employability in local and national industries
- CO2: Learn the synthesis of different Non-steroidal Anti-inflammatory Drugs for employability
- CO3: Learn the characteristics and methods of synthesis of antibiotics, antiviral, antibacterials and anti-fungal drugs
- CO4: Understand the fermentation method for the production of various drugs, antibiotics and other organic molecules for employability and skill development

**Suggested Readings:**

1. G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, UK.
2. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi.
3. William O. Foye, Thomas L., Lemke, David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi.

**Web Sources:**

- <https://guides.lib.uiowa.edu/c.php?g=132196&p=863259>
- <https://stuvera.com/pharmaceutical-chemistry-books-pdf/>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 2   | 3   | 3   | 2   | 3   | 1   | 3   | 2   | 3    | 3    | 3    |
| CO2 | 3   | 2   | 3   | 3   | 3   | 2   | 2   | 3   | 3   | 3    | 3    | 3    |
| CO3 | 3   | 2   | 3   | 3   | 3   | 2   | 2   | 3   | 3   | 3    | 2    | 3    |
| CO4 | 3   | 2   | 3   | 3   | 2   | 3   | 2   | 2   | 2   | 3    | 3    | 3    |

**CO- Curriculum Enrichment Mapping (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 2             | 2                |
| CO2 | 3                 | 3             | 3                |
| CO3 | 3                 | 3             | 3                |
| CO4 | 3                 | 3             | 3                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (IV Semester)**  
**MCHDE-404(B): COSMETIC CHEMISTRY**  
**Departmental Elective-II**

**Objectives:** Cosmetic chemistry will provide students with the opportunities to develop professional skills and fundamental concepts driving cosmetic science to focus on the needs of the cosmetic industry and its consumers, in addition to providing students with the critical and evaluative skills to become professional scientists for entrepreneurship & employability in cosmetic industries.

**Unit –I** **(09 Sessions)**

Raw Materials for Cosmetics

Surfactants (basic, mild anionic, amphoteric, non-ionic and cationic), shampoo and bath additives (thickeners, foam stabilizers, conditioning agents, emollients and sequestering agents), oil components (mineral, natural and synthetic oils) for skill development of formulation of cosmetic products.

**Unit –II** **(09 Sessions)**

Hair Dyes (Preparation and properties)

Temporary, semi-permanent and permanent hair dyes, dye removers and stability testing of dyes to develop entrepreneurship skills for the formulation of hair care product

**Unit – III** **(09 Sessions)**

Skin Care Products (Preparation and Properties)

Formulation of skin care products (stability and microbiological testing of skin care products), Skin cleansers: anhydrous oily cleansers, super fatted bar soaps, astringents/toners, bar soaps. Moisturisers, anti-aging products and sun screen products to develop entrepreneurship skill for the formulation of skin care product

**Unit –IV** **(09 Sessions)**

Colour Cosmetics, perfumes and oral care products (Preparation and properties)

Lip colour, nail polish, face powders, foundation, blushers, eye shadow, mascara, eyeliners.

Perfumes and deodorants: Natural and synthetic perfumes, fragrance, fixative and solvents.

Oral Care products: Toothpaste formulation, oral rinses, anti-caries agents for entrepreneurship and employability.

**Course Outcomes:**

Students completing this course will able to:

CO1: Gain knowledge about the raw materials used to prepare cosmetic products for entrepreneurship and employability at local and national level

CO2: Learn about the preparation and properties of various kinds of hair dyes

CO3: Formulate and characterize various skin care products for entrepreneurship and employability

CO4: Learn practical skills in the area of cosmetics, perfumes and oral care products required to scientifically design and develop these products



**Suggested readings**

1. Chemistry and Technology of the Cosmetics and Toiletries Industry, S.D. Williams, W.H. Schmitt.
2. The Chemistry of Fragrances: From Perfumer to Consumer, Charles Sell
3. Chemical Technology of Cosmetics, Kirk-Othmer, John Wiley & Sons.

**Web Sources:**

- <https://sp-sg.libguides.com/c.php?g=377339&p=6724406>
- <https://chemistscorner.com/top-10-book-cosmetic-science-book-resources/>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 3   | 3   | 3   | 3   | 2   | 1   | 2   | 2   | 1   | 3    | 3    | 3    |
| CO2 | 3   | 2   | 3   | 3   | 3   | 2   | 3   | 2   | 3   | 3    | 3    | 3    |
| CO3 | 3   | 2   | 3   | 3   | 3   | 2   | 3   | 3   | 3   | 3    | 3    | 3    |
| CO4 | 3   | 2   | 3   | 3   | 2   | 2   | 2   | 1   | 2   | 3    | 3    | 3    |

**CO- Curriculum Enrichment Mapping (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|     | Skill Development | Employability | Entrepreneurship |
|-----|-------------------|---------------|------------------|
| CO1 | 3                 | 3             | 3                |
| CO2 | 3                 | 3             | 3                |
| CO3 | 3                 | 3             | 3                |
| CO4 | 3                 | 3             | 3                |

**IFTM University, Moradabad**  
**Master of Science (Chemistry) Programme**  
**M.Sc. (Chemistry) II Year (IV Semester)**  
**MCHCC-451: ORGANIC CHEMISTRY PRACTICAL-II**

**(20 Sessions)**

**Objectives:** To learn the quantitative analysis of different functional groups like phenolic, in the given organic compound. Also to know the method of synthesis of various name reactions of industrial applications for the skill development for employability in organic synthesis industries.

- A. Quantitative Analysis for skill development in estimation of organic synthesis compound in laboratories and industries
- a) Estimation of Functional Groups-
    - 1. Estimation of phenolic group  
Determine the strength of the given phenol solution by brominating method.
    - 2. Estimation of amine :  
Determine the strength of the given aniline solution by brominating method.
    - 3. Estimation of carbohydrate:  
Determine the strength of the given glucose solution by Fehling's solution method or iodometrically.
    - 4. Estimation of oil and fats:
      - a) Determine the saponification value of the given oil or fat.
- B. Organic Synthesis for skill development and employability:
- i) Sandmeyer's reaction-
    - a) Preparation of o-chloro benzoic acid from anthranilic acid.
  - ii) Wurtz Fittig Reaction-  
Preparation of di benzyl from benzyl chloride.
  - iii) Friedel Craft Reaction-  
Preparation of benzophenone from benzoyl chloride and benzene.
  - iv) Hoesch Reaction-  
Preparation of 2, 4 di- hydroxyl acetophenone from resorcinol.
  - v) Pechmann Reaction-  
Preparation of 7- hydroxyl -4-methyl coumarin from resorcinol.
  - vi) Perkin's Reaction-  
Preparation of cinnamic acid from benzaldehyde.
  - vii) Pinacol-Pinacolone Rearrangement-  
Preparation of benzopinacolone from benzophenone.
- C). Extraction of Organic Compounds from Natural Sources
- i). Isolation of Piperine from black pepper.
  - ii). Isolation of lycopene from tomatoes.
  - iii). Isolation of carotene from carrots.
  - iv). Isolation of limonene from citrus fruits
4. Viva voce
5. Record

**Course outcomes:**

Students completing this course will be able to:

- CO1: Demonstrate ability for basic organic chemistry laboratory techniques, including Distillation, recrystallization, melting point determination, liquid-liquid extraction, gravity and liquid filtration, and chromatography for skill development and employability in local and national industries
- CO2: Demonstrate the ability to safely and effectively perform synthetic organic reactions, using proper glassware set-up, handling of hazardous chemicals, and following the prescribed experimental procedures
- CO3: Isolate organic compounds from natural sources for skill development and employability
- CO4: Estimate or prepare various organic compounds

**Suggested Readings:**

1. Experimental Organic Chemistry Vol I &II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
2. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
3. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell. ELBS
4. Experiments in General Chemistry, C.N.R. Rao and U.C. Agarwal, East-West Press.

**Web sources:**

- <http://chemcollective.org/vlabs>
- <http://chemcollective.org/physical>
- <https://www.vlab.co.in/broad-area-chemical-sciences>

**Note: Latest edition of all the suggested readings must be used.**

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | 3   | 3   | 3   | 3   | 2   | 1   | 3   | 3   | 1   | 3    | 3    | 3    |
| <b>CO2</b> | 3   | 3   | 3   | 3   | 3   | 3   | 2   | 3   | 3   | 3    | 3    | 3    |
| <b>CO3</b> | 3   | 2   | 3   | 3   | 2   | 2   | 2   | 2   | 2   | 3    | 3    | 3    |
| <b>CO4</b> | 3   | 2   | 2   | 3   | 2   | 2   | 2   | 2   | 2   | 3    | 3    | 3    |

**CO- Curriculum Enrichment Mapping (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

|            | Skill Development | Employability | Entrepreneurship |
|------------|-------------------|---------------|------------------|
| <b>CO1</b> | 3                 | 3             | 2                |
| <b>CO2</b> | 3                 | 3             | 1                |
| <b>CO3</b> | 3                 | 3             | 1                |
| <b>CO4</b> | 3                 | 3             | 2                |