# PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

## DEPARTMENT OF CHEMISTRY

### ACADEMIC YEAR: 2022-2023

### PROPOSED COURSE STRUCTURE TO BE IMPLEMENTED FROM 2023-2023 ONWARDS

| SEMESTER | CORE COURSES | | | | | MULTI DISIPLINARY COURSES | INTERNSHIP | SKILL ENHANCEMENT COURSES |
|---|---|---|---|---|---|---|---|---|
| I | **Core – 1** General Physical and Inorganic Chemistry | --- | --- | --- | **Minor Stream (Core – 1)** General Physical and Inorganic Chemistry | **MDC-1** Basic Chemistry **MDC-2** Selected Topics in Organic and Inorganic Chemistry | --- | **SEC-1** Skill Development in Chemistry-I |
| II | **Core – 2** General Organic and Inorganic Chemistry | --- | --- | --- | **Minor Stream (Core – 2)** General Organic and Inorganic Chemistry | **MDC-3** Selected Topics in Food Chemistry MDC -4 Chemistry in Everyday Life | --- | **SEC-2** Skill Development in Chemistry-II |
| III | **Core – 3** Concepts in Physical and Inorganic Chemistry | **Core – 4** Concepts Organic and Inorganic Chemistry | | --- | **Minor Stream (Core – 3)** Concepts in Physical and Inorganic Chemistry | **MDC** | --- | **SEC-3** Skill Development in Chemistry-III |
| IV | **Core – 5** Comprehensive Inorganic Chemistry | **Core – 6** Comprehensive Organic Chemistry | **Core – 7** Comprehensive Physical Chemistry | **Core – 8** Applied Chemistry – I<br>Applied Chemistry – II | **Vocational** | --- | --- | --- |
| V | **Core – 9** Advanced Physical Chemistry -I | **Core – 10** Advanced Organic Chemistry -I | **Core – 11** Advanced Inorganic Chemistry -I | **Core – 12** Applied Chemistry- III | **Vocational** | --- | Internship | --- |
| VI | **Core – 13** Advanced Physical Chemistry -II | **Core – 14** Advanced Organic Chemistry -II | **Core – 15** Advanced Inorganic Chemistry -II | **Core – 16** Project<br>Applied Chemistry- IV | **Vocational** | --- | --- | --- |
| VII | **Core – 17** Bio-Inorganic Chemistry/ Coordination Chemistry | **Core – 18** Surface Chemistry and Catalysis | **Core – 19** Stereochemistry and Name Reaction | **Core – 20** Research Methodology | **Minor Stream (Core – 4)** Concepts Organic and Inorganic Chemistry | --- | --- | --- |
| VIII | **Core – 20** Organometallic Chemistry | **Core – 21** Electrochemistry | **Core – 22** Heterocyclic Chemistry OR Synthetic Organic Chemistry | **Core – 23** Nanomaterials and Solid State Reactions | **Minor Stream Core – 5** Comprehensive Inorganic Chemistry | --- | Dissertation | --- |

# PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

## DEPARTMENT OF CHEMISTRY

**ACADEMIC YEAR: 2022-2023**

**PROPOSED DRAFT SYLLABI**

**COURSE SYLLABUS TO BE IMPLEMENTED FROM ACADEMIC YEAR: 2023-2024**

## SEMESTER I AND SEMESTER II

## SEMESTER- I

**CORE COURSE**
**THEORY**
**Course Code:**
**Course Title: General Physical and Inorganic Chemistry**
**Credits: 3**
**Duration: 45 Hours**
**Maximum Marks: 75**

**Course Objectives:**

1. Will have a working knowledge of the main areas of Physical Chemistry, will develop critical thinking abilities and be able to work in chemical or related fields.
2. Will help to get better understanding about the basics of Physical and Inorganic Chemistry.
3. Will be able to carry out experiments with required skills.

**Course Outcomes:**

**CO1:** Apply mathematical concepts to solve the chemical reaction problem.
**CO2:** Apply symmetry rules used in X-ray diffraction studies to day today examples.
**CO3:** Apply the gas laws and interpret the PV isotherms of gases.
**CO4:** Use the hybridization and LCAO approximations to different geometry molecules.
**CO5:** Skill development by performing practical in Inorganic and Physical Chemistry.

### SECTION- I (PHYSICAL CHEMISTRY)

**UNIT I: Mathematical Concepts in Chemistry** **06 hours**

Logarithmic relations; Rules of logarithm, Characteristic and mantissa, change of sign and base, problems based on pH and pOH. Graphical representation of equations: Curve sketching, linear graphs, and calculation of slopes. Differentiation of functions: Kx, ex (exponential), sin x, log x, maxima, and minima. Integration of some useful functions. Interconversion of units.

**UNIT II: Chemical Kinetics** **08 hours**

Rate of reaction, factors influencing rate of the reaction- concentration, temperature, pressure, solvent, and catalyst. Mathematical characteristics: zero, first and second order reactions. Determination of order of reaction: Integrated rate equation method, graphical method, differential method, half-life method and isolation method. Effect of temperature on the rate of the reaction, Arrhenius equation (derivation not expected) and concept of activation energy (Numerical expected).

**UNIT III: The Solid State** **08 hours**

Introduction, difference between crystalline and amorphous solids, laws of crystallography: law of constancy of interfacial angles, law of symmetry and law of rationality of indices, Miller and Weiss

indices. Elements of symmetry and symmetry operations, introduction to point groups, lattice and unit cells. X ray diffraction by crystals and Bragg's equation. (Numerical expected).

**UNIT IV: The Gaseous State** **08 hours**

Kinetic molecular theory of gases, its postulates and derivation of kinetic gas equation. Gas laws, ideal gas equation, compressibility factor, the van der Waal's correction factors and it's equation of state. Liquefaction of gases: critical phenomena, PV isotherms of $CH_4$ and $CO_2$ , relationship between critical constants and van der Waal's constants, the law of corresponding states and reduced equation of state. Maxwell distribution of molecular velocities and its use in evaluating average, root mean square and most probable velocities.

## SECTION- II (INORGANIC CHEMISTRY)

**UNIT V: Atomic Structure and the Periodic Table** **05 hours**

Atomic spectra of hydrogen, Bohr's model of hydrogen atom, probability picture of electron, dual nature of electrons, Heisenberg uncertainty principle, Schrodinger wave equation, quantum numbers, shapes of s, p, d, orbitals, Aufbau and Pauli exclusion principles, Hund's rule of maximum multiplicity, sequence of energy levels and arrangement of elements in groups in the periodic table, periodic trends and effective nuclear charge.

**UNIT VI: Covalent Bonding** **10 hours**

Covalent bond: Valence Bond Theory (VBT) and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, Valence Shell Electron Pair Repulsion Theory (VSEPR) applied to NH3, H3O+, SF4, ClF3, ICl - and H2O, Molecular Orbital Theory, homonuclear and heteronuclear diatomic molecules (CO and NO), multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

**PRACTICALS**
**Course Code: CHE- I.C-1**
**Course Title: General Physical and Inorganic Chemistry (Practicals)**
**Credit: 1**
**Duration: 30 Hours**
**Maximum Marks: 25**

**LIST OF EXPERIMENTS:**
**PHYSICAL CHEMISTRY**

1. Preparation of standard solutions based on normality, molarity, molality. Also, further dilutions from a standard solution to a volume of 50 mL. [Multiple solutes may be used] **(2 hours)**

2. To study the solubility of benzoic acid at room and below room temperature by volumetric method. **(2hours)**

3. To determine the relative strength of two acids i.e., HCl and H2SO4 by using them as catalysts for the hydrolysis of methyl acetate. **(2 hours)**

4. To investigate the order of the reaction between K2S2O8 and KI using equal initial concentrations of both the reactants. **(4 hours)**

5. To study the hydrolysis of methyl acetate using two different initial concentrations in presence of mineral acid **(**HCl) as catalyst **(4 hours)**

6. To study the molecular condition of benzoic acid in toluene-water system. **(4 hours)**

7. To study the kinetics of Iodine-Clock reaction. **(4 hours)**

8. To study the oxidation of iodide ions by hydrogen peroxide as an iodine clock reaction. **(4 hours)**

**INORGANIC CHEMISTRY**

1. Preparation of standard solutions and to carry out the dilution to 0.05, 0.01, 0.001 M **(2 hours)**

2. To prepare 100 ppm Manganese solution using KMnO4 and carry out the further dilutions like 5, 10, 20 ppm. **(2 hours)**

3. To prepare 0.1 N Na2C2O4 solution and use it to standardize the given KMnO4 solution. **(2 hours)**

4. Preparation of chrome Red **(2 hours)**

5. Preparation of ferrous ammonium sulphate. **(2 hours)**

**PHYSICAL CHEMISTRY TEXT BOOK:**

Atkins, P., Paula, J. D. *Atkins' Physical Chemistry*, Oxford University Press.

**INORGANIC CHEMISTRY TEXT BOOKS:**

1.Atkins, P., Overton, T., Rourke, J., Weller, M., Armstrong, F., *Shriver and Atkins' Inorganic Chemistry*, Oxford University Press.

**ADDITIONAL READING:**

1. Bahl A., Bahl B. S. and Tuli, G. D. *Essentials of Physical Chemistry*, S. Chand and Company Ltd., New Delhi.

2. Puri B. R., Sharma L. R. and Pathania M. S., *Principles of Physical Chemistry*, Vishal Publishing Co.

3. Raj G., *Advanced Physical Chemistry*, Goel Publishing House, Meerut.

4. Greenwood, N. N., Earnshaw, A., *Chemistry of Elements*, Pergamon, Oxford.

5. Huheey, J. E., Keiter, E. A., Keiter, R. L., Medhi, O. K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson.

6. Cotton, F. A., Wilkinson, G., *Advanced Inorganic Chemistry*, Wiley Publications.

7. Puri, B. R., Sharma, L. R., Kalia, K. C. *Principles of Inorganic Chemistry*, Vishal Page 6 of 73 Publishing Co.

8. Housecroft, C. E. and Sharpe, A. G., *Inorganic Chemistry*, Prentice Hall.

**PRACTICAL BOOK:**

1. Khosla B. D., Garg V. C., Gulati A., Senior Practical Physical Chemistry, S. Chand and Co., New Delhi
2. Mendham J., Barnes J. D., Denney R. C., Thomas M. J., Sivasankar B., *Vogel's Text book of Quantitative Chemical Analysis*, Pearson.

**WEB REFERENCES:**

1.http://alpha.chem.umb.edu/chemistry/ch115/Mridula/CHEM%20116/documents/chapter_14auLectureSlides_000.pdf

2. https://www.livescience.com/53304-gases.html

3. https://www.slideshare.net/kumar_vic/solid-state-chemistry-17237117

4.https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Physical_Properties_of_Matter/States_of_Matter/Properties_of_Gases/Kinetic_Theory_of_Gases/Basics_of_Kinetic_Molecular_Theory

5. https://www.thoughtco.com/valence-shell-electron-pair-repulsion-theory-605773

6. https://www.britannica.com/science/covalent-bond

7. https://www.electrical4u.com/schrodinger-wave-equation/

8. http://www.chem4kids.com/files/atom_structure.html

9. https://pubchem.ncbi.nlm.nih.gov/periodic-table/

**MULTI DISIPLINARY COURSES**

**Course Code: CHE-MDC-1**
**Course Title: Basics in Chemistry**
**Credits: 2**
**Duration: 30 Hours**
**Maximum Marks: 75**

**Course Objectives:**
1. To make students understand about the basic theoretical concepts in chemistry.
2. To provide knowledge to students about the diverse laboratory apparatus, equipment, and laboratory safety.
3. To provide the knowledge about the different types of pollution, its harmful effects and green chemistry.
4. To provide basic practical knowledge by performing experiments in laboratory.

**Course Outcomes:**
On successful completion of the course, the student will be able to:
**CO1:** Understand the basic concepts in chemistry.
**CO2:** Explain different laboratory apparatus, equipment and safety measures.
**CO3:** Discuss different types of pollution, its related harmful effects; importance of green chemistry.
**CO4:** Explain different concepts in green chemistry.
**CO5:** Develop practical skill by performing basic chemistry experiments in laboratory.

**UNIT I: Introduction to Chemistry** **15 Hours**
Introduction, Classification: Organic, Inorganic, Physical and Analytical, Reactants, products, catalysts (with two examples)
Physical: States of matter: solids, liquids, and gases
Organic: Nomenclature and classification of some basic organic compounds (Hydrocarbons: Alkanes, alkenes and alkynes, alcohols, amines, and carboxylic acids with examples), and selected applications. Purification techniques of solids (recrystallization, sublimation) and liquids (distillation)
Inorganic: Atomic structure and type of bonds: ionic, covalent, metallic, acids and bases, metals, non-metals, noble gases.
Analytical: Knowledge of basic chemistry instruments, preparation of solutions, standardization, normality, molarity, and molality.

**UNIT II: Pollution and Green Chemistry** **15 Hours**
Types of pollution: Air, Water, Noise: Sources, harmful effects, hazards associated with flora and fauna, measures to control, upcoming methods for air/water pollution treatment Acid rain: causes and harmful effect with an example of effect on Taj mahal, Corrosion Rusting of iron, its causes and prevention, Impact of Toxic chemicals in environment, Pollutants and their statutory limits; 12 principles of green chemistry with one example, Global warming, Greenhouse gases, Greenhouse effect, Hydrochemistry: Reaction of water with atmospheric gases, Renewable and non-renewable sources of energy (examples) and its conservation.

**PRACTICALS**
**Course Code: CHE-MDC-I**
**Course Title: Basics in Chemistry**
**Credits: 1**

**Duration: 30 Hours**
**Maximum Marks: 25**
**LIST OF EXPERIMENTS:**
1. Purification techniques of solid: Recrystallization **(2 h)**
2. Purification techniques of solid: Sublimation **(2 h)**
3. Purification techniques of liquids: Distillation **(2 h)**
4. Stoichiometric calculation for preparation of solutions **(2 h)**
5. Preparations of solution in terms of normality, molarity, ppm, percent **(2 h)**
6. Standardisation of solution: Acid and base **(4 h)**
7. Total hardness of water **(2 h)**
8. Determination of alkanity of water **(2 h)**
9. Determination of acidity of water **(2 h)**
10. Demonstration experiments on conductometer and pH meter **(4 h)**
11. Identification of Chemical type of organic compounds (any three) **(6 h)**

**TEXT BOOKS:**
1. Gurdeep, R. Advanced Physical Chemistry, 27th Edition; Goel Publishing House, Meerut
2. Morrison, R. T. et. al. Organic Chemistry Pearsons publications, Noida India.
3. Shriver, D. F. et. al. Inorganic Chemistry, 5th Edition, Oxford University Press
4. Skoog, D. A., et. al. Fundamentals of Analytical Chemistry, 8th Edition

**REFERENCE BOOKS:**
1. Ahluwalia, V. K.; Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi.
2. Cooper, M. M.; Cooperative chemistry laboratory manual, International Editions McGraw-Hill Companies
3. Furniss, B. et. al. Vogel's Textbook of Practical Organic Chemistry, Pearson education
5. Iqbal, S. A. et. al. Chemistry of Air and Air Pollution Discovery Publishing House, New Delhi
6. Matlack, A. S. et. al.; Introduction to Green Chemistry, CRC Press, New York
7. Puri, B. R. et. al. Principles of Physical Chemistry
8. Tyagi, O. D. et. al. A Text Book of Environmental Chemistry Anmol Publications, New Delhi
**WEB REFERENCES:**
1. https://wou.edu/chemistry/files/2017/01/CH105-Chapter-8-PDF-file.pdf
2.https://mysite.science.uottawa.ca/sgambarotta/sites/default/files/CHM%201311F/slide%20show/molecule/Ch08-12%20molecules.pdf
3.https://www.hansrajcollege.ac.in/hCPanel/uploads/elearning/elearning_document/Twelve_principle_of_GC.pdf
4. http://eagri.org/eagri50/ENVS302/pdf/lec07.pdf

**Course Code: CHE-MDC-2**
**Course Title: Selected Topics in Organic and Inorganic Chemistry**
**Credits: 2**
**Duration: 30 Hours**
**Maximum Marks: 75**
**Course Objectives:**

1. To make students understand about the basic theory concepts in chemistry.
2. To provide knowledge to students about the organic reaction mechanism.
3. To provide knowledge about the different types of orbitals
4. To provide basic practical knowledge by performing experiments in laboratory.

**Course Outcomes:**

On successful completion of the course, the student will be able to:

**CO1:** Understand the basic concepts in chemistry.

**CO2:** Learn the nomenclature of organic compound.

**CO3:** Discuss different types of hydrocarbons.

**CO4:** Discuss the atomic structure, periodic table, and inorganic materials chemistry.

**CO5:** Develop practical skill by performing basic chemistry experiments in laboratory.

**UNIT I: Basics in Organic Chemistry** **15 Hours**

Structure, nomenclature, classification, properties and applications of organic compounds with different functional groups: amines, nitro compounds, cyanides and isocyanides, ethers, alcohols, aldehydes, ketones, carboxylic acids, esters, cycloalkanes, benzene, substituted benzene compounds such as phenols, toluene, nitrobenzene, aniline and halobenzene.

Organic compounds shape, structure, hybridization of carbon; structure and stability of carbocation, carbanion and free radicals; electrophile, nucleophile; homolytic and heterolytic cleavage, isomerism, keto-enol tautomerism; substitution reactions: $S_N^1$ and $S_N^2$, elimination reactions: $E_1$, $E_2$ and $E_{1cb}$, inductive and mesomeric effects, aromaticity, resonance, resonating structures, oxidation and reduction reactions.

**UNIT II: Chemical Bonding** **15 Hours**

Types of bonds; Ionic bond: nature of ionic bond, factors favoring formation of ionic compounds, properties of ionic compounds, examples of ionic compounds. Covalent bond: Lewis concept of covalent bond, factors favouring the formation of covalent compounds, Valence Shell Electron Pair Repulsion Theory (VSEPR) applied to $H_2O$, $NH_3$, $H_3O^+$, $SF_4$, $ICl^-$ and $ClF_3$. Valence Bond Theory (VBT) and its limitations, types of hybridization and shapes of simple inorganic molecules and ions, sigma and pi bonds. Molecular Orbital Theory: LCAO method, homonuclear ($N_2$, $O_2$, and $O_2^{2-}$) and heteronuclear diatomic molecules (NO and CO), Bond order and bond strength. Co-ordinate bonds: conditions for the formation of co-ordinate bond, properties of co-ordinate compounds. Metallic bond: nature of metallic bond, properties of metallic compounds. Hydrogen bond: inter-hydrogen and intra-hydrogen bonding in compounds, properties of hydrogen bond. Van de Waals forces: types of Van de Waals forces with examples.

**PRACTICALS**

**Course Code: CHE-MDC-2**

**Course Title: Selected Topics in Organic and Inorganic Chemistry**

**Credits: 1**

**Duration: 30 Hours**

**Maximum Marks: 25**

**LIST OF EXPERIMENTS:**

1. Preparation of oxime of acetophenone **(2 h)**
2. Nitration of acetanilide **(2 h)**
3. Qualitative analysis of only solid organic compounds: Acid, phenol, bases, amides, anilides, hydrocarbons, carbohydrates (any two) **(2 h)**
4. Preparation of 2,4-dinitrophenylhydrazone of acetophenone **(2 h)**
5. Preparation of Iodoform **(2 h)**

6. Preparation of standard solutions and to carry out the dilution to 0.05, 0.01, 0.001 M in 50 mL standard volumetric flask **(2 h)**
7. To prepare 100 ppm Manganese solution using $KMnO_4$ and carry out the further dilutions like 5, 10, 20 ppm in 50 mL standard volumetric flasks **(2 h)**
8. Preparation of oxime of benzaldehyde **(2 h)**
9. Preparation of pyridinium chlorochromate **(2 h)**
10. Preparation of 2,4-dinitrophenylhydrazone of benzaldehyde **(2 h)**
11. To prepare 0.1 N $Na_2C_2O_4$ solution and use it to standardize the given $KMnO_4$ solution **(2 h)**
12 Preparation of Potassium tri(oxalato)ferrate (III) trihydrate.
13. Standardisation of HCl against $Na_2CO_3$
14. Preparation of $MnO_2$
15. Preparation of Ni-DMG complex

**TEXT BOOK:**

1. Morrison, R. T., Boyd, R. N. and Bhattacharjee, S. K., Organic Chemistry, Pearson India.
2. Atkins P. W., Overton T. L., Rourke J. P., Weller M. T. and Armstrong F. A., Shriver and Atkins Inorganic Chemistry, Oxford University Press.

**REFERENCE BOOKS:**

1. Bruice, P. Y., Organic Chemistry, Pearson India.
2. Carey, F. C. and Giuliano, R. M., Organic Chemistry, Tata McGraw-Hill India.
3. Finar, I. L. Organic Chemistry, 6th edition, volume 1, Pearson India.
4. March, J., Advanced Organic Chemistry Reaction, Mechanism and Structure, 4th Edition, Wiley Publications.
5. Greenwood, N. N., Earnshaw, A., Chemistry of Elements, Pergamon, Oxford.
6. Huheey, J. E., Keiter, E. A., Keiter, R. L., Medhi, O. K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Edu.
7. Lee J. D., Concise Inorganic Chemistry, Wiley-India.
8. Cotton F. A. and Wilkinson G., Basic Inorganic Chemistry, Wiley Eastern Ltd.

**PRACTICAL TEXT BOOK:**

1. Furniss, B., Brian, S., Vogel's Textbook of Practical Organic Chemistry, Pearson education.
2. Mendham J., Barnes J. D., Denney R. C., Thomas M. J., Sivasankar B., Vogel's Text book of Quantitative Chemical Analysis, Pearson.

**WEB REFERENCES:**

1. https://www.visionlearning.com/en/library/Chemistry/1/Chemical-Bonding/55
2. https://unacademy.com/content/neet-ug/study-material/chemistry/types-of-bonding/
3. https://www.vedantu.com/chemistry/hybridization
4. https://www.toppr.com/guides/chemistry/chemical-bonding-and-molecular-structure/molecular-orbital-theory/

**SKILL ENHANCEMENT COURSE**

**THEORY**
**Course Code: CHEM-SEC**
**Course Title: Skill Development in Chemistry - I**
**Credits: 2**
**Duration: 30 Hours**

**Maximum Marks: 45**

**Course Objectives:**

1. To understand the chemistry of fats, oils and the process involved in preparing soaps, detergents and disinfecting agents and provide necessary skills for the preparation.
2. To study the composition and chemical parameters of commonly consumed beverages like soft drinks and packed fruit juices, the process involved in their preservation and their long-term effects on human health.
3. To study the various food additives like food colours, taste enhancers, preservatives, etc. and their effects on food and health. Food adulteration of commonly used kitchen ingredients like wheat, rice, dal, milk, butter, etc. and the tests involved to detect the adulterants will be studied.

**Course Outcomes:**

On successful completion of the course the students will be able to:

**CO1:** Determine the saponification value, iodine value and acid values of oils; test the adulterants in food items.

**CO2:** Apply the skills for the preparation of white phenyl and liquid soap.

**CO3:** Understand chemistry of soaps, synthetic detergents, alkyl-aryl sulphonates and floor cleaners.

**CO4:** Determine the pH of soft drinks and other beverages.

**CO5:** Understand the chemistry of food additives and adulterants; apply the knowledge for detecting and testing foods items for adulterants.

**UNIT I: Fats and Oils** **8 Hours**

Introduction to fats and oils: Chemical nature, physical and chemical properties.

Types: Natural fats, saturated fats, unsaturated fats different types of edible and industrial oils of vegetable origin, common fatty acids, and glycerides.

Quality parameters of oil: Acid value, Saponification value, Iodine value, peroxide value, moisture content, Reichert- Meissl (RM) value and smoke point.

Hydrogenation of oil, Rancidity of oil, good and bad effects on health.

**UNIT II: Soaps, Detergents and Disinfecting agents** **7 Hours**

Soaps: Chemical composition, Structure of molecule and its preparation, properties of soaps, method of preparation. Detergents: Chemical composition, natural and synthetic detergents, alkyl and aryl sulphonates, properties of detergents and method of preparation. Micelle formation, Kraft's temperature, critical micellar concentration, mechanism of cleansing action of soap and difference between soaps and detergents. Floor cleaners- preparation, storage and disposal of white phenyl.

**UNIT III: Beverages, Food Additives and Adulterants 15 Hours**

Soft drinks, soda, fruit juices and alcoholic beverages (Types and content of alcohol). Composition of soft drinks, and its excessive use leading to urinary bladder stones. Preservation in tetra pack. Nitrogen preservation and packing of fruit juices. Food additives:

**PRACTICALS**
**Course Code: CHEM-SEC**
**Course Title: Skill Development in Chemistry -I**
**Credits: 2**
**Duration: 30 Hours**
**Maximum Marks:**

**LIST OF EXPERIMENTS**

1. Preparation of household cleaners a) Floor deodorant b) Dish wash liquid c) Liquid soap d) Detergent powder e) Soap bar (Any 3 to be performed) 2 hours each

2. To determine the Iodine number of a) Sunflower oil b) Coconut oil c) Olive oil d) Vanaspati ghee e) Palm oil (Any 2 to be performed) 2 hours each
3. To determination the saponification value of oils a) Palm oil b) Castor oil c) Coconut oil. (Any 2 to be performed) 3 hours each
4. To determine the pH and acidity using pH meter (2 samples each) a) soft drinks b) fruit juices c) Energy drinks (Any 2 to be performed) 4 hours each
5. Test for presence of adulterants in food items (turmeric powder, chilli powder, vanaspati ghee, milk, coffee, pulses, tea leaves, sugar, pepper, edible oils, jaggery,honey etc) 6 hours

**REFERENCES BOOKS:**

1. Battershall, J. P. *Food Adulteration and its detection*, ebook.
2. Belitz, H. D. etal., *Food Chemistry*. 4th Edition, Springer.
3. Branen, A. L. etal., *Food Additives*. 2nd Edition, Marcel Dekker, Inc.,
4. Fennema, O. R., *Food Chemistry*, Marcel Decker Inc., NewYork.
5. Madan, R. L., *Chemistry for Degree Students: T. Y. B. Sc. Students,* 2nd Edition, S. Chand Publications.

**WEB REFERENCES:**

1. https://www.wikihow.com/Formulate-White-Phenyle
2. https://www.youtube.com/watch?v=33NysscBs1k
3. https://www.wisegeek.com/what-are-the-most-common-hand-sanitizer-ingredients.htm
4. https://www.sciencedirect.com/topics/food-science/food-adulteration
5. https://fssai.gov.in/
6. https://www.who.int/news-room/fact-sheets/detail/food-additives

## SEMESTER- II

**CORE COURSE**
**THEORY**
**Course Code:**
**Course Title: General Organic and Inorganic Chemistry**
**Credits: 3**
**Duration: 45 Hours**
**Maximum Marks: 75**

### SECTION- I (ORGANIC CHEMISTRY)

**Course Objectives:**

1. Students will learn about the basic concepts in organic chemistry, like the hybridization in organic molecules, molecular interactions, etc.
2. Students will briefly learn about the types of reaction, reactive intermediates, and reaction mechanism in organic chemistry.
3. Students will learn how to represent 3 D structures of organic molecules on 2 D surfaces.
4. Students will learn three important classes of organic compounds i.e., alkanes, alkenes and alkynes.
5. Students will develop skills to carry out related experiments.

**Course Learning Outcomes:**

On successful completion of the course, the student will be able to:
**CO1**: Understand the fundamentals of organic chemistry.
**CO2**: Delineate the concept of stereochemistry and acquire knowledge of aliphatic

hydrocarbons.

**CO3**: Identify given unknown organic compounds (solid) by carrying out various chemical tests and synthesize some organic derivatives.

**CO4:** Predict available oxidation states for s- and p-block elements.

**CO5:** Apply the knowledge of Normality and Molarity in preparation of different solutions.

**UNIT I: Fundamentals of Organic Chemistry** **10 Hours**

Bond formation in organic compounds; sp, $sp^2$, $sp^3$ with respect to methane, ethene and acetylene (hybridisation concept), discussion on shape, bond length, bond angles of organic molecules; polar covalent bonds, electronegativity and bond dipoles in organic molecules, introduction and examples of Van der Waal's forces, inductive effect, field effect, hyperconjugation and resonance, hydrogen bonding; curved arrows in organic chemistry, homolytic and heterolytic bond breaking; types of reagents: electrophiles and nucleophiles; types of organic reactions: addition, elimination, substitution, oxidation, reduction and rearrangement with examples; introduction to reactive intermediates: carbocations, carbanions, free radicals, carbenes, arynes and nitrenes with shape, stabilities, methods of formation and reaction; methods of determination of reaction mechanisms: determination of structure, intermediates, isotope effects, kinetic and stereochemical studies.

**UNIT II: Stereochemistry** **10 Hours**

Concept of isomerism, types of isomers: constitutional, conformational (ethane, butane and cyclohexane) and configurational isomerism; chirality (upto two chiral carbons), enantiomers and diastereomers (with example of threo and erythro diastereomers, D and L, meso compounds); representation of configuration by- 3D Projection (Wedge and dotted projection), Fischer projection, Newmann projection and Saw horse projection and their interconversions; Can-Ingold-Prelog sequence rules: R/S configuration (for upto 2 chiral carbons) and E/Z nomenclature (for upto two C=C systems).

**UNIT III: Study of aliphatic hydrocarbons** **10 Hours**

Alkanes and Cycloalkanes**:** Physical properties of alkanes and cycloalkanes (stability of alkanes to be explained using Baeyer strain theory), sources of alkanes and cycloalkanes; chemical properties: combustion and pyrolysis of alkanes; methods of preparation: Corey-House reaction, Wurtz reaction.

Alkenes: Physical properties and relative stabilities of alkenes; preparation of alkenes: elimination reactions (regioselectivity to be explained using The Zaitsev rule)- dehydration of alcohols and dehydrohalogenation of alkyl halides (E1 and E2 mechanisms); reactions of alkenes: hydrogenation, addition of halides and hydrogen halides, regioselectivity of hydrogen halide addition, hydroboration and oxidation reactions, oxymercuration-demercuration reactions, epoxidation of alkenes, ozonolysis of alkenes.

Alkynes: Sources of alkynes, physical properties of alkynes, acidity of acetylene and terminal alkynes, preparation of alkynes by elimination reactions (from tetra halides and vicinal dihalides), conversion of acetylene and terminal alkynes into higher alkynes; reactions of alkynes: hydrogenation, reactions with Lindlar catalyst, metal-ammonia reduction, addition of hydrogen halides, hydration of alkynes.

## SECTION- II (INORGANIC CHEMISTRY)

**UNIT V: Chemistry of s-block elements** **05 hours**

General properties, comparative study within groups, diagonal relationship, salient features of hydrides, solvation and complexation tendencies and biological importance, introduction to alkyls and aryls.

**UNIT VI: Chemistry of p-block Elements** **10 hours**

Comparative study within group and diagonal relationship of groups 13, 14, 15, 16, 17; Hydrides of Boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), phosphazenes, tetra sulfur tetranitride, basic properties of halogens, inter halogens and poly halides.

**PRACTICALS**
**Course Code: CHE-I.C-2**
**Course Title: General Organic and Inorganic Chemistry**
**Credit: 1**
**Duration: 30 Hours**
**Maximum Marks: 25**

**LIST OF EXPERIMENTS:**

**ORGANIC CHEMISTRY**

1. Purification of solid organic compounds by recrystallization followed by determination of melting point:
   a. Benzoic acid from water; b. m-Dinitrobenzene from ethanol (2 hours)
2. Purification of solid organic compounds by sublimation:
   a. Naphthalene b. Anthracene c. Camphor (any two) (2 hours)
3. Organic Synthesis:
   a. Benzoylation of β-naphthol and aniline. (2 hours)
   b. Bromination of aromatic compounds using $KBrO_3$ (2 hours)
   c. Anthraquinone from anthracene (Oxidation reaction) (2 hours)
4. Qualitative Analysis (Solids) (2 hours/compound)
   Acids: Benzoic, salicylic, phthalic
   Phenols: α-Naphthol, β-naphthol
   Bases: p-Toluidine, diphenylamine, o-, m- and p-nitro anilines
   Anilides: Acetanilide, benzanilide
   Hydrocarbons: Naphthalene, anthracene
   Amides: Benzamide, urea
   Haloarenes: p-Dichlorobenzene
   Nitro Compounds: m-Dinitrobenzene, p-nitrotoluene
   Carbohydrates: Glucose, fructose, mannose.
   (At least six compounds to be given)

**INORGANIC CHEMISTRY**

1. To prepare 0.001 M EDTA and separately estimate the amount of $Zn^{2+}$ ion from $ZnCO_3$, $Mg^{2+}$ ion from MgO.
2. Volumetric estimation of $Fe^{2+}$ using internal indicator by potassium dichromate method.
3. To determine the alkali content in antacid tablet using standard HCl solution.
4. Volumetric estimation of Calcium from anhydrous Calcium Chloride.
5. To determine the Total Dissolved Solids (TDS) of Magnesium Sulphate.

**ORGANIC CHEMISTRY TEXT BOOK:**

1. Morrison, R. T., Boyd, R. N. and Bhattacharjee, S. K., Organic Chemistry, Pearson India.

**INORGANIC CHEMISTRY TEXT BOOKS:**

1. Lee, J. D., *Concise Inorganic Chemistry*, ELBS Publications.
2. Atkins, P., Overton, T., Rourke, J., Weller, M., Armstrong, F., Shriver, and Atkins' InorganicChemistry, Oxford University Press.

**PRACTICAL TEXT BOOK:**

1. Furniss, B., Brian, S., Vogel's Textbook of Practical Organic Chemistry, Pearson education.
2. Mendham J., Barnes J. D., Denney R. C., Thomas M. J., Sivasankar B., Vogel's Text book of Quantitative Chemical Analysis, Pearson.

**ADDITIONAL READING:**


1. Bhattacharjee J. etal, Textbook of Chemistry, First edition, Rajhauns vitaran, Panaji Goa.
2. Bruise P. Y., Organic Chemistry, 7th Edition, Pearson Education Pvt. Ltd. New Delhi India.
3. Carey F., Organic Chemistry; 8th Edition, Tata McGraw Hill Education Pvt. Ltd. New Delhi India.
4. Greenwood, N. N., Earnshaw, A. *Chemistry of Elements*, Pergamon, Oxford. Huheey, J. E., Keiter, E. A., Keiter, R. L., Medhi, O. K., *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson.
5. Cotton, F. A., Wilkinson, G., *Advanced Inorganic Chemistry*, Wiley Publications. Puri, B. R., Sharma, L. R., Kalia, K. C., *Principles of Inorganic Chemistry*, Vishal Publishing Co.
6. Sharpe and Emilus, InorganicChemistry.
7. Housecroft, C. E. and Sharpe, A. G. *Inorganic Chemistry*, Prentice Hall.


**WEB REFERENCES:**

1. https://www.khanacademy.org/science/organic-chemistry/bond-line-structures-alkanes-cycloalkanes
2. https://www.khanacademy.org/science/organic-chemistry/gen-chem-review
3. https://www.khanacademy.org/science/organic-chemistry/substitution-elimination-reactions
4. https://www.khanacademy.org/science/organic-chemistry/stereochemistry-topic
5. https://www.khanacademy.org/science/organic-chemistry/alkenes-alkynes
6. https://depts.washington.edu/eooptic/linkfiles/The%20Elements.pdf

**MULTI DISIPLINARY COURSES**

**Course Code: CHE-MDC-3**
**Course Title: Selected Topics in Food Chemistry**
**Credits: 2**
**Duration: 30 Hours**
**Maximum Marks: 75**

**Course Objectives:**

1. To make students understand about the importance of lipids, carbohydrates, food additives and beverages in food chemistry.
2. To provide practical chemistry knowledge by performing some selected experiments related to food chemistry in laboratory.
3. To understand the carbohydrate cycle.

**Course Outcomes:**

On successful completion of the course, the student will be able to:
**CO1:** Understand the importance of lipids such as fats, oils, and waxes in food chemistry.
**CO2:** Explain the chemistry of carbohydrates in food chemistry.
**CO3:** Discuss properties, classification, and applications of food enzymes in food chemistry.
**CO4:** Explain food additives and beverages in food chemistry.
**CO5:** Develop practical skill on selected experiments related to food chemistry in laboratory.

**UNIT I: Carbohydrates, Proteins and Lipids** **15 Hours**

Carbohydrates: Nomenclature, chemical composition, and classification: Mono-, di-, oligo-, and polysaccharides, sources, physical and chemical properties, functions, general reactions of glucose.

Amino acids, peptides, Proteins: structure, function, chemical composition, classification of proteins, types of proteins based on structure: primary, secondary, tertiary and quartenary proteins.

Fats and oils: sources, nomenclature and classification, chemical composition, fatty acids, constituents and application of fat and oil from plants such as palm oil, canola oil, sunflower oil, coconut oil, groundnut oil, olive oil, corn oil and sesame seed oil. Properties of fats and oils, chemical reactions such as; hydrolysis, hydrogenation, transesterification, rancidity, polymerization and hydrogenolysis. Analysis: saponification value, acid value, iodine value, ester value, acetyl value, Reichert value; methods of extraction and industrial scale production of oils, oil refining, side reactions during oil processing.

Waxes: sources, nomenclature and classification, chemical composition, characteristics of waxes, constituents, and applications of candelilla wax, jojoba wax, sunflower wax, rice bran wax, beeswax.

**UNIT II: Food Additives and Food contaminants** **15 Hours**

Food additives: Definition, function, classification, its important role as antioxidants, flavour enhancers such as monosodium glutamate, emulsifiers and stabilizers; Sugar substitutes and artificial agents: Nutritive and non-nutritive sweeteners with examples; nutrients supplement such as vitamins, amino acids, minerals, etc. buffers, leavening agents such as yeast, oxidizing and reducing agents. Food colours, pigments and other colorants: Importance, classification into natural and synthetic food colours with examples.

Preservation of food: Importance of preservatives, its classification and methods of food preservation.

Food contaminants: microbial contamination, pesticides, halogenated hydrocarbons, heavy metals; occurrence, source and effect on health.

**PRACTICALS**

**Course Code: CHE-MDC-3**
**Course Title: Selected Topics in Food Chemistry**
**Credits: 1**
**Duration: 30 Hours**
**Maximum Marks: 25**

**LIST OF EXPERIMENTS:**

1. Hydrolysis of fats and oils **(4h)**
2. Determining the presence of carbohydrate in different samples by using Fehling's Test and iodine test **(2h)**
3. Determining the presence of carbohydrate in different samples by using Seliwanoff's Test and Bial's Test **(2h)**
4. Hydrolysis of sucrose **(2h)**
5. Hydrolysis of starch **(2h)**
6. Estimation of glucose in the given sample **(2h)**
7. Extraction of volatile oil from lemon peel **(2h)**
8. Extraction of volatile oil from orange peel **(2h)**
9. Separation of amino acids by paper chromatography **(2h)**
10. To determine the concentration of glycine solution by formylation method **(2h)**
11. Extraction of caffeine from coffee **(2h)**
12. Extraction of caffeine from soft drinks **(2h)**
13. Extraction of caffeine from tea powder **(2h)**

14. Tests to differentiate between a reducing and nonreducing sugar **(2h)**

**REFERENCES:**

1. Aurand, L. W. and Wood, A. E. (1973). Food Chemistry. The AVI Publishing Co., Connecticut.
2. Belitz, H. D., Grosch, W. and Schieberler, P. (2004). Food Chemistry. Springer, Berlin.
3. DeMan, J. M. (1999). Principles of Food Chemistry. A Chapman and Hall Food Science Book, Aspen Publ., Inc., Gaithersburg, Maryland.
4. Fennama, O. R. (ed). (1996). Food Chemistry. Marcel Dekker, Inc., New York.
5. Gopalan, C., Rama Sastri, B.V., and Balasubramaniam, S.C. (1991). Nutritive value of Indian Foods. National Institute of Nutrition (NIN), Indian Council of Medical Research (ICMR), Hyderabad.
6. Meyer, L. H. (1976). Food Chemistry. Reinhold Publ. Corporation, New York.
7. Potter, N. M. (1995). Food Science. The AVI Publishing Co., Connecticut.
8. Ogori AF, J Food Sci Nutr 2020, 6: 060
9. W.F. Tinto1 , T.O. Elufioye2 and J. Roach1 1University of the West Indies, Cave Hill Campus, St. Michael, Barbados, 2University of Ibadan, Ibadan, Oyo State, Nigeria

**WEB REFERENCES:**

1. https://sintak.unika.ac.id/staff/blog/uploaded/5812002253/files/fats_&_oils.pdf
2.https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/2017/Oils-Fats-Waxes-Notes.pdf
3.https://www.sathyabama.ac.in/sites/default/files/course-material/2020-10/note_1456404597.pdf
4.https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004120825284090vidyanand_trip_Additives_for_Beverages_1.pdf
5.http://www.ilsi-india.org/conference_on_foods_additives_Safety_and_benefits/Food%20Additives%20in%20Beverages%20Needs%20and%20Perception,%20Mr.%20Sunil%20Adsule,%20Treasurer,%20ILSI-India.pdf

**Course Code: CHE-MDC-4**
**Course Title: Chemistry in Everyday Life**
**Credits: 2**
**Duration: 30 Hours**
**Maximum Marks: 75**

**Course Objectives:**

1. To make students understand about the chemistry of cosmetics, disinfectants, drugs, and dyes.
2. To provide practical knowledge of chemistry involved in the preparation of some selected household items used in everyday life.

**Course Outcomes:**

On successful completion of the course, the student will be able to:
**CO1:** Understand the chemistry of various cosmetics used in everyday life.
**CO2:** Discuss the chemistry of diverse drugs and their applications.
**CO3:** Understand the chemistry and uses of selected dyes.
**CO4:** Understand the chemistry of dye synthesis.
**CO5:** Develop practical skill by preparing selected household items used in everyday life.

**UNIT I: Chemistry in day today Life** **15 Hours**

General importance of chemistry in life, chemical composition, preparation and uses of toothpaste, shampoos, nail polish, nail polish remover, powder, creams, body lotions, hair dyes, lipstick, perfumes, cosmetics, antiperspirants. Essential oils and their importance in cosmetic industries with reference to eugenol, geraniol, sandalwood oil, eucalyptus, 2-phenyl ethyl alcohol. Packaging of cosmetics: filling of solids, semi solids and liquids, materials used for cosmetic packaging, rules and regulations, and legal provisions for packaging and labelling.

**UNIT II: Drugs and Dyes** **15 Hours**

Drugs: Introduction to drugs, definition, importance, history of drug discovery, classification of drugs, nomenclature, and structure of drugs with at least two examples under each class: analgesics, anaesthetics, anti-pyretic, anti-microbial, antibiotics, vasodilators, anti-HIV agents, anti-inflammatory agents, anti-laprosy, cardiovascular agents; routes of drug administration and different dosage forms and applications.

Dyes: Introduction, nomenclature and classification of dyes, textile and edible dyes and fabric brighteners, methods of preparation and uses of methyl orange, malachite green, indigo, bismark brown, alizarin.

**PRACTICALS**

**Course Code: CHE-MDC-4**
**Course Title: Chemistry in Everyday Life**
**Credits: 1**
**Duration: 30 Hours**
**Maximum Marks: 25**

**LIST OF EXPERIMENTS:**

1. Preparation of shampoo **(2 h)**
2. Preparation of cold cream **(2 h)**
3. Preparation of shaving cream **(2 h)**
4. Preparation of talcum powder **(2 h)**
5. Preparation of antiseptic **(2 h)**
6. Preparation of nail polish and nail polish remover **(2 h)**
7. Preparation of herbal lipstick **(2 h)**
8. Preparation of perfume **(2 h)**
9. Preparation of Methyl Orange dye **(2 h)**
10. Preparation of Indigo dye **(2 h)**
11. Preparation of azo dye **(4 h)**
12. Synthesis of Aspirin **(2 h)**
13. Extraction of essential oil from lemon grass **(2 h)**
14. Extraction of essential oil from eucalyptus **(2 h)**

**REFERENCES:**

1. Finar, I. L. Organic Chemistry, 6$^{th}$ edition, volume 1, Pearson
2. G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, UK.
3. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi.
4.William O. Foye, Thomas L., Lemke, David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt Ltd. New Delhi.
5. Jayashree Ghosh: Text Book of Pharmaceutical Chemistry, 2nd edition, S. Chand & Company, New Delhi

**WEB REFERENCES:**

1.http://klepharm.edu/media/uploads/sem7_pharmaceutics_cosmetology_and_cosmetic_preparation.pdf
2. https://www.actascientific.com/ASPS/pdf/ASPS-04-0553.pdf
3. https://www.unodc.org/pdf/publications/report_2003-09-01_1.pdf
4. https://old.amu.ac.in/emp/studym/99996749.pdf

*********