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Shri Acharyaratna Deshbhooshan Shikshan Prasarak Mandal, Kolhapur

# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

## Affiliated to Shivaji University, Kolhapur

Syllabus for Bachelor of Science

Part-I

Chemistry

**DSC**

(NEP-2.0)

To be implemented from

June, 2023 onwards

## Bachelor of Science

## Credit Framework

### First-Year (B. Sc. I-Chemistry)

| Level | Sem. | Subject-1 (Chemistry) | Subject-2 | Subject-3 | IDC/MDC/OE/GE | SEC | AEC, VEC, IKS | | | OJT, FP, CEP, CC, RP | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DSC | DSC | DSC | OE | SEC | AEC | VEC | IKS | CC | FP/OJT | RP/ Dissert. | |
| 4.5 | I | ICH-101 Paper-I Inorganic Chemistry (2 Cr) | DSC-I (2 Cr) | DSC-I (2 Cr) | CHOEPR-101 Practical Paper-I Water Analysis (2 Cr) | -- | -- | -- | IKS-I (2 Cr) Introducti on to IKS | -- | -- | -- | -- |
| | | OCH-102 Paper-II Organic Chemistry (2 Cr) | DSC-II (2 Cr) | DSC-II (2 Cr) | | | | | | | | | |
| | | PRCH-103 Practical Paper-I (2 Cr) | DSC-P-I (2 Cr) | DSC-P-I (2 Cr) | | | | | | | | | |
| | **Credits** | **4(T)+2(P) =6** | **4(T)+2(P) =6** | **4(T)+2(P) =6** | **2 (P) =2** | **--** | **--** | **--** | **2(T)** | **--** | **--** | **--** | **22** |
| | II | PCH-201 Paper-III Physical Chemistry (2 Cr) | DSC-III (2 Cr) | DSC-I (2 Cr) | CHOEPR-201 Practical Paper-II Soil Analysis (2 Cr) | -- | -- | VEC-I (2 Cr) Democracy, Election and Constitution | -- | -- | -- | -- | -- |
| | | ACH-202 Paper-IV Analytical Chemistry (2 Cr) | DSC-IV (2 Cr) | DSC-II (2 Cr) | | | | | | | | | |
| | | PRCH-203 Practical Paper-II (2 Cr) | DSC-P-II (2 Cr) | DSC-P-II (2 Cr) | | | | | | | | | |
| | **Credits** | **4(T)+2(P)=6** | **4(T)+2(P) =6** | **4(T)+2(P) =6** | **2 (P)=2** | **--** | **--** | **2(T)** | **--** | **--** | **--** | **--** | **22** |
| **Total Credits** | | **12** | **12** | **12** | **4** | **--** | **--** | **2** | **2** | **--** | **--** | **--** | **44** |
| | | **Exit Option: Award of UG Certificate in Major with 44 Credits and an additional 4 credits core NSQF course/ Internship/Skill Courses OR Continue** | | | | | | | | | | | |

## Structure of B. Sc. I Chemistry

| Sr. No. | Semester | Title of Paper |
|---|---|---|
| 1 | I | ICH-101 Paper-I, Inorganic Chemistry (2 credits, 30 Hours) |
| 2 | | OCH-102 Paper -II, Organic Chemistry (2 credits, 30 Hours) |
| 3 | | PRCH-103 Practical Paper-I (2 credits, 60 Hours) |
| 4 | II | PCH-201 Paper -III, Physical Chemistry (2 credits, 30 Hours) |
| 5 | | ACH-202 Paper -IV, Analytical Chemistry (2 credits, 30 Hours) |
| 6 | | PRCH-203 Practical Paper-II (2 credits, 60 Hours) |

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**(New syllabus NEP to be implemented from June, 2023 onwards)**

| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **I** | Semester | **I** |
| Course | **Chemistry** | Course Code | **DSC B1** |
| Paper No. | **I** | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2023 - 24** |
| Total Credits | **02** | Contact Hours | **02 / Week** |
| Course Title | **INORGANIC CHEMISTRY** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | To aware elements and their respective places in periodic table. |
| ii) | To learn the concept of bonding. |
| iii) | To understand hybridization geometries of compounds. |
| iv) | To develop skill of molecular orbital diagram. |

| **C) Course Syllabi:**<br>(CR = Credits =02/ IH: Instructional Hours) | |
|---|---|
| **Modules** | **IH** |
| **Module I: Atomic Structure & Periodicity of Elements and Ionic bonding** | 09 |
| **1. Atomic Structure & Periodicity of Elements** | |
| 1.1 Introduction, Bohr's theory of hydrogen, wave particle duality, Heisenberg uncertainty principle. | |
| 1.2 Quantum numbers, shapes of s, p, d & f atomic orbitals. | |
| 1.3 Aufbau's principle, Hunds rule of maximum multiplicity, Pauli's exclusion principle. | |
| 1.4 General electronic configuration of s, p, d & f | |
| 1.5 Periodicity of the s block elements | |
| **2. Ionic Bonding** | 07 |
| 2.1 Introduction, Definition, formation and General characteristics of ionic bond. | |
| 2.2 Energy calculation in Ionic bond formation. | |

| | |
|---|---|
| 2.3 Born-Haber cycle for NaCl and its applications | |
| 2.4 Fajan's Rule, Applications of Fajan's rule for,<br>• Polarizing power and polarizability<br>• Ionic character in covalent compounds<br>• Bond moment, dipole moment and percentage ionic character | |
| **Module II: Valence bond theory and Molecular orbital theory** | 07 |
| **1. Valence bond theory (VBT)** | |
| 1.1 Inroduction, Concept of hybridization, different types of hybridization | |
| 1.2 Geometry of<br>• sp hybridization,<br>• $sp^2$ hybridization,<br>• $sp^3$ hybridization | |
| 1.3 Geometry of<br>• $sp^3d$ hybridization,<br>• $sp^3d^2$ hybridization,<br>• $sp^3d^3$ hybridization | |
| **2. Molecular orbital theory (MOT)** | 07 |
| 2.1 Introduction, LCAO method, formation of bonding, anti-bonding and nonbonding molecular orbitals, comparison between bonding and antibonding. | |
| 2.2 Conditions and types of overlaps<br>• -S-S,<br>• S-px,<br>• Px-Px, Py-Py,<br>• Pz-Pz . | |
| 2.3 Bond order with its significance and energy level sequence for molecular orbital when n=1 & 2. | |
| 2.4 MO diagrams for,<br>• Homonuclear diatomic molecule.<br>• Heteroatomic diatomic molecule. | |

| **D) Course Outcomes:** | |
|---|---|
| CO1 | Discuss and understand periodic table atomic structure. |
| CO2 | Identify characteristic of Ionic compounds |
| CO3 | Acquire knowledge about hybridization geometries of compounds. |
| CO4 | Develop knowledge about molecular orbital diagram. |

| E) Reference Materials | |
|---|---|
| **E1) Text Books for Reading** | |
| **1.** | Phadake |
| **2.** | Nirali |
| **E2) Books for Reference** | |
| **1.** | Concise Inorganic Chemistry ELBS, J.D. Lee, 1991. |
| **2.** | Basic Inorganic Chemistry, Cotton, F.A., Wilkinson, G. & Gaus, P.L. 3rd ed., Wiley. |
| **3.** | Concepts and Models in Inorganic, B.E. Douglas, D.H. Mc Daniel & J.J. Alexander. |
| **4.** | Chemistry, John Wiley & Sons. |
| **5.** | Inorganic Chemistry, J.E. Huheey, , E.A. Keiter, , R.L. Keiter, & O.K. Medhi, |
| **6.** | Principles of Structure and Reactivity, Pearson Education India, 2006. |
| **7.** | Principles of Inorganic Chemistry, Puri, Sharma, Kalia. |
| **8.** | Madan R. L.Chemistry for Degree Students (B. Sc. First year),S. Chand Publications |

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| A) Primary Information: | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **I** | Semester | **I** |
| Course | **Chemistry** | Course Code | **DSC B2** |
| Paper No. | **II** | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2021 - 22** |
| Total Credits | **02** | Contact Hours | **02 / Week** |
| Course Title | **ORGANIC CHEMISTRY** | | |

| B) Course Objectives: | |
|---|---|
| i) | To aware about fundamentals of organic chemistry. |
| ii) | To understand stereo chemistry. |
| iii) | To understand concept of aliphatic hydro carbon with respect to reactivity and stability. |
| iv) | To recognised concept of aromaticity . |

| C) Course Syllabi:<br>(CR = Credits = 02 / IH: Instructional Hours) | |
|---|---|
| **Modules** | **IH** |

| | |
|---|---|
| **Module I: Fundamentals of Organic Chemistry and Stereochemistry** | 08 |
| **1. Fundamentals of Organic Chemistry** | |
| 1.1 Introduction, and basic concept of organic reactions, Bonds formation and cleavage, mechanism of curves arrow notation. | |
| 1.2 Types of reactions and reagents: Nucleophiles (negative and neutral) and electrophiles (positive and neutral). Electronic Displacements | |
| 1.3 Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation effect, electron-withdrawing group. | |
| | |
| 1.4 Reactive Intermediates: Generation, Structure, Stability and Reactions of Carbocations, Carbanions and free radicals. | |
| **2. Stereochemistry** | 09 |
| 2.1 Introduction, Types of Stereoisomerism | |
| 2.2 Optical Isomerism: Concept of Chirality | |
| 2.3 Elements of Symmetry, Optical Isomerism in tartaric acid, 2, 3 Dihydroxybutanoic acid, Enantiomerism, Diastereomerism and Meso compounds. | |
| 2.4 Geometrical isomerism in C=C, C=N and alicyclic compounds. | |
| 2 .5 Nomenclature of stereoisomers: D and L, erythro and threo, R and S, E and Z | |
| **Module II- Aliphatic Hydrocarbons and Aromaticity** | 07 |
| **1. Aliphatic Hydrocarbons** | |
| 1.1 Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. | |
| 1.2 Reactions: Free radical Substitution: Halogenation. | |
| 1.3 Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). | |
| 1.4 Alkynes: (Upto 5 Carbons) Preparation: reactions- formation of metal acetylides, addition of bromine and alkaline $KMnO_4$. | |
| **2. Aromaticity** | 06 |
| 2.1 Introduction, Characteristics properties of organic compounds. | |
| 2.2 Classification of Aromatic compound. | |

| |
|---|
| 2.3 Structure of Benzene: Kekule structure, Resonance structure, M.O. picture, |
| 2.4 Modern theory of Aromaticity, Mechanism of Electrophilic substitution reactions: Nitration, Sulphonation, Halogenation and Friedel craft reaction. |

| **D) Course Outcomes:** | |
|---|---|
| CO1 | Improve knowledge fundamental terms of organic chemistry. |
| CO2 | Gained knowledge of stereo chemistry. |
| CO3 | Identify aliphatic hydro carbons like alkane, alkene and alkyne. |
| CO4 | Recognised aromaticity. |

| **E) Reference Materials** | |
|---|---|
| **E1) Text Books for Reading** | |
| **1.** | Organic Chemistry by Phadake Publication |
| **2.** | Organic Chemistry by Nirali Publication |
| **E2) Books for Reference** | |
| **1.** | Organic Chemistry, Jonathan Claden, Nick Greeves & Stuart Warren. |
| **2.** | *Advanced Organic Chemistry,* Bahl, A. & Bahl, B.S. S. Chand, 2010. |
| **3.** | Chemistry for Degree Students, R. L. Madan, (B. Sc. First Year), S. Chand.Publication |
| **4.** | Guidebook to Mechanism in Organic Chemistry, Sykes, P. A. Orient Longman, New Delhi (1988). |
| **5.** | Organic Chemistry, Morrison, R.T. & Boyd, R.N. Pearson, 2010. |
| **6.** | Stereochemistry of Carbon Compounds, E.L. Eliel, Tata McGraw Hill education, 2000. |
| **7.** | Stereochemistry of Organic compounds, D.Nasipuri : |

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| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **I** | Semester | **I** |

| Course | **Chemistry** | Course Code | **-** |
|---|---|---|---|
| Paper No. | **I** | Course Type | **Semester** |
| Total Marks | **25 Marks** | Implementation | **2021 - 22** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **PRACTICALS IN CHEMISTRY** | | |

## A) Inorganic Chemistry (Any Six)

1. To prepare standard 0.1N$KMnO_4$ solution and to determine the strength of given oxalic acid solution.
2. To determine quantity of Fe(II) ions from the given solutions by titrating it with 0.1N$K_2Cr_2O_7$ solution by using internal indicator
3. To estimate amount of Cu (II) ions by iodometric titration by using $Na_2S_2O_3$ solution.
4. To standardize supplied EDTA solution by titrating with 0.01 M $ZnSO_4$ solution and to estimate amount of calcium from given solution by using Erio – Tasan indicator.
5. Quality control- To determine percentage purity of the given sample of sodaash $Na_2CO_3$ by titrimetric method.
6. Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method
7. Chromatography: Separation and identification of cations by Paper Chromatographic technique from the following mixtures:

   a) $Ni^{2+}$+$Cu^{2+}$

   b) $Ni^{2+}$+$Co^{2+}$

## B) Organic Chemistry

### 1. Estimations (any two):

1. Estimation of aniline.(bybromination method)
2. Estimation of acetamide.
3. Estimation of Aspirin.

2. Organic Qualitative Analysis: Detection of physical constant, type, functional group, elements, and Confirmatory test.

Identification of Organic Compounds (at least eight) (four containing at least one extra element-N, S, Cl, Br, I)

a) Acids: Oxalic acid, Benzoic acid, cinnamic acid

b) Phenols: Beta-Naphthol, Resorcinol

c) Base: Aniline, p-Nitroaniline

d) Neutral: Acetone, Acetanilide, Chloroform, m-Dinitrobenzene, Thiourea, Bromobenzene

3. Purification of organic compounds by crystallization (from water and alcohol) and distillation.

**References:**


1) Vogel's Text Book of Quantitative Chemical Analysis. (Longmann) ELBS Edition.
2) Hand book of Organic Qualitative Analysis: Clarke.
3) Comprehensive Practical Organic Chemistry – Qualitative Analysis by V. K. Ahluwalia, Sunita Dhingra. University Press. Distributor – Orient Longman Ltd.
4) Comprehensive Practical Organic Chemistry preparation and Quantitative Analysis: V. K. Ahluwalia, Renu Aggarwal. University Press. Distributor – Orient Longman Ltd.
5) A Laboratory Hand - Book of Organic Qualitative Analysis and Separation: V. S. Kulkarni. Dastane Ramchandra & Co. Pune

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| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **I** | Semester | **II** |
| Course | **Chemistry** | Course Code | **DSE B3** |
| Paper No. | **III** | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2021 - 22** |
| Total Credits | **02** | Contact Hours | **02 / Week** |
| Course Title | **Physical Chemistry** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | To understands the graphical representation and processing. |
| ii) | To learn the concept enthalpy and understands enthalpy changes in various chemical processes. Defines effect temperature on enthalpy of reaction, Determines Bond energies from thermochemical data |
| iii) | To understand specific behaviour of gases. |
| iv) | To distinguish between first , second and zero order reaction |

| **C) Course Syllabi:**<br>(CR = Credits= 02 / IH: Instructional Hours) | |
|---|---|
| **Modules** | **IH** |
| **Module I: Mathematical concept of Chemistry and Chemical energetics** | |
| **1. Mathematical concept of Chemistry** | |
| 1.1 Graph: Cartesian co-ordinates, Plotting of graph from experimental data, equation of straight line, slope, Intercept & its characteristics. | |
| 1.2 Derivative: Definition, Simple rules of differentiation partial differentiation, examples related to chemistry. | |

| | |
|---|---|
| 1.3 Integration: Definition, Simple rules of Integration, Integration between limits, examples related to chemistry | **06** |
| **2. Chemical Energetics** | |
| 2.1 Thermodynamics: Introduction, Basic concepts of thermodynamics, First law of thermodynamics, Spontaneous and non-spontaneous process with examples | 10 |
| 2.2 Statements of second law of thermodynamics, Carnot's cycle and its efficiency. Entropy, Physical Significance of entropy, Statement of Third | |
| Law of thermodynamics and calculation of absolute entropies of substances. | |
| 2.3 Thermochemistry: Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. | |
| 2.4 Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. | |
| **Module II: Kinetic Theory of Gases and Chemical kinetics** | |
| **1. Kinetic Theory of Gases** | |
| 1.1 Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Ideal and Non ideal gases | |
| 1.2 Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. Van der Waals equation of state for real gases.<br>Explanation of real gas behaviour by Van der Waal's equation | |
| 1.3 Boyle temperature (derivation not required). Critical Phenomena:<br>PV-isotherms of real gases (Andrew's isotherms), Continuity of state, Critical constants and their calculation from vander Waals equation. | |
| 1.4 Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Numerical Problems. | 07 |

| **2. Chemical Kinetics** | |
|---|---|
| 2.1 Introduction, Rate of reaction, Definition and units of rate constant, Factors affecting rate of reaction. (Nature of reactant, Concentration, pressure, temperature and catalyst.) Order and Molecularity of reaction. | 07 |
| 2.2 Zero order reaction, First order reaction, Characteristics of first order reaction. examples, Pseudo-unimolecular reactions, examples. Second order reaction: Derivation of rate constant for equal and unequal concentration of the reactants. | |
| 2.3 Characteristics of Second order reaction., Determination of order of reaction by i) integration method ii) graphical method iii) Half life method, Effect of temperature on rate of reaction. | |
| 2.4 Arrhenius equation, Concept of energy of activation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). Numerical problems. | |

| **D) Course Outcomes:** | |
|---|---|
| CO1 | Recognised differentiation and integration in chemical derivation. |
| CO2 | Able to defines laws of thermodynamics and explains the concept of entropy |
| CO3 | Able to understand the basic difference with physical phenomenon of gases. |
| CO4 | Understand molecularity of reaction, Arrhenius equation, pseudo unimolecular reactions |

| **E) Reference Materials** | |
|---|---|
| **E1) Text Books for Reading** | |
| **1.** | Phadake |
| **2.** | Nirali |
| **3.** | Chemistry for Degree students (B. Sc. First Year): R L Madan (S. Chand and Company) |
| **E2) Books for Reference** | |
| **1.** | Under graduate physical chemistry, UGC curriculum Vol. I – GuriaGurtu Pragati Prakashan |
| **2.** | Principles of physical chemistry- Puri,Sharma,Pathania 44th publication and Vishal Publication |

| | |
|---|---|
| **3.** | Mathematical preparation of Physical Chemistry : F. Daniel ,McGraw Hill Book Company Ltd. |
| **4.** | Principles of Physical Chemistry Puri, Sharma and Pathania, Vishal Publishing House, 44th Edition |
| **5.** | Advanced Physical Chemistry Gurdeep Raj GOEL Publishing House, 36th Edition |
| **6.** | Essentials of Physical Chemistry,Bahl , Tuli and Bahl |
| **7.** | Text Book of Physical Chemistry, Soni and Dharmarha |
| **8.** | Elements of Physical Chemistry : S. Glasstone and D.Lewis ( D.Van Nostrand Co.Inc) |
| **9.** | Physical Chemistry : W. J. Moore (Orient Longman) |
| **10.** | Principles of Physical Chemistry : Maron Prutton |
| **11.** | University Chemistry: B. H. Mahan (Addision - Weseley Publ. Co.) |


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| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **I** | Semester | **II** |
| Course | **Chemistry** | Course Code | **DSC B4** |
| Paper No. | **IV** | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2021 - 22** |
| Total Credits | **02** | Contact Hours | **02 / Week** |
| Course Title | **ANALYTICAL CHEMISTRY** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | Development of analytical skills in students |
| ii) | To develop and understanding of the range and uses of analytical methods in chemistry |

| | |
|---|---|
| iii) | To provide an understanding of chemical methods employed for elemental and compound analysis |
| iv) | To develop interdisciplinary approach of the subject for students opting for specialisation in other subjects at later stages of graduation |

| **C) Course Syllabi:**<br>(CR = Credits=02 / IH: Instructional Hours) | |
|---|---|
| **Modules** | **IH** |
| **Module I: Introduction to analytical Chemistry and Chromatography** | 06 |

| | |
|---|---|
| **1. Introduction to analytical Chemistry** | |
| 1.1 Introduction, Importance of analysis | |
| 1.2 Analytical processes (Qualitative and Quantitative), Methods of analysis (Only classification) | |
| 1.3 Sampling of solids, liquids and gases, Classification of separation method. | |
| 1.4 Errors, types of errors (determinate and indeterminate), methods of expressing accuracy (Absolute and relative error), Significant figures, mean, median, standard deviation (Numerical problems expected) | |
| **2. Chromatography** | ( |
| 2.1 Introduction, Basic Principle of Chromatography, Basic terms, Classification of Chromatography, advantages of chromatography | |
| 2.2 Paper Chromatography- Principle, Methodology-types of papers and treatment, sample loading, choice of solvent, developmentascending, descending, circular, location of spots, determination of $R_f$ value, Applications, advantages and disadvantages | 06 |
| 2.3 TLC- Principle, Methodology | |
| 2.3 Comparison of paper chromatography and TLC, | |

| | |
|---|---|
| **Module II: Theory of titrimetric Analysis and Water & Fertilizer analysis** | 06 |
| **1. Theory of titrimetric Analysis** | |
| 1.1 Introduction, Acid-base indicators, Theory of indicators w.r.t. Ostwald's ionization theory and quinoid theory | |
| 1.2 Neutralization curves and choice of indicators for Strong acid – strong base, Weak Acid- Strong Base, Weak Base- Strong acid | |
| 1.3 complexometric titrations<br>a. Introduction<br>b. Types EDTA titrations<br>c. Metallochromic indicators-Eriochrome black- T<br>d. Indicator Action of Eriochrome black- T | |
| **2. water analysis** | 06 |
| 2.1 Introduction | |
| 2.2 Chemical Analysis – Total Dissolved solids , Hardness, Salinity, Alkalinity, Acidity, Sulphates, Nitrates, Dissolved Oxygen, Chemical Oxygen Demand, Biological Oxygen Demand | |
| 2.3 physical analysis | |
| 2.4 industrial uses | |
| 3. **fertilizer analysis** | 06 |
| 3.1 Introduction, Types of fertilizers<br>3.2 Necessity and requirements of good fertilizers Sampling and sample preparation<br>3.3 Analysis of Nitrogen by Kjeldahl's method<br>3.4 Analysis of Phosphorus by phosphomolybdate method<br>3.5 Analysis of Potassium by sodium tetraphenyl borate method | |

| D) Course Outcomes: | |
|---|---|
| CO1 | -Understand the Basic Concepts Analytical Process & Classification of Analysis.<br>-Able to solve numerical problem.<br>– Students understand sampling methods, Errors and Significant figures |
| CO2 | Understand chromatography, types of chromatography, mobile phase, stationary phase & calculate $R_f$ value . |
| CO3 | Recognized basic concepts that is solute, solvents, solution and types of indicators and titrations. |
| CO4 | Understand water analysis techniques and its purification. |

| E) Reference Materials | |
|---|---|
| **D1) Text Books for Reading** | |
| **1.** | Phadake |
| **2.** | Nirali |
| **D2) Books for Reference** | |
| **1.** | Textbook of quantitative Inorganic analysis-A.I. Vogel |
| **2.** | Instrumental methods of Chemical analysis-H. Kaur |
| **3.** | Instrumental methods of Chemical analysis-B.K. Sharma |
| **4.** | Instrumental methods of Chemical analysis-Chatwal Anand |
| **5.** | Fundamental of analytical Chemistry-Skoog and West |
| **6.** | Basic Concepts of analytical Chemistry-S.M. Khopkar |
| **7.** | Analytical Chemistry-Alka Gupta (Pragati Prakashan) |
| **8.** | Indian Pharmacopoeia |
| **9.** | Chromatography-H. Kaur |
| **10.** | Chemistry for Degree students (B.Sc. First Year): R. L. Madan (S. Chand and Company) |

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| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **I** | Semester | **II** |
| Course | **Chemistry** | Course Code | **-** |
| Paper No. | **II** | Course Type | **Semester** |
| Total Marks | **25 Marks** | Implementation | **2021 - 22** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **PRACTICALS IN CHEMISTRY** | | |

## A) Physical Chemistry

### Physical Chemistry (Any Six)

1. Determination of equivalent weight of Mg by Eudiometer.
2. Study of specific reaction rate of hydrolysis of methyl acetate in presence of HCl.
3. Determination of heat of ionization of weak acid by using polythene bottle.
4. Determination of heat capacity of calorimeter for different volumes.
5. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
6. Determination of integral enthalpy of solution of salts ($KNO_3$, $NH_4Cl$).
7. Determination of enthalpy of hydration of copper sulphate.
8. Study of the solubility of benzoic acid in water and determination of $\Delta H$.

## B) Analytical Chemistry:

1) Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method
2) Estimation of Aspirin tablet.
3) Estimation of Vitamin C from fruit juice.
4) Determination of Cell constant of given conductivity cell using KCl solution. (N/10 and N/50 KCl) (Solutions should be prepared by the students).
5) Preparation and standardization of $HCl/H_2SO_4$ solution from the bulk.
6) Separation and identification of amino acids by paper chromatography.
7) Estimation of Ca from pharma tablets by complexometric method.

**References:**


1) Practical book of Physical Chemistry: Nadkarni, Kothari & Lawande.
2) Experimental Physical Chemistry: A. Findlay.
3) Systematic Experimental Physical Chemistry: S. W. Rajbhoj, Chondhekar. (Anjali Publication.)
4) Experiments in Physical Chemistry: R. C. Das and B. Behra. (Tata McGraw Hill)
5) Advanced Practical Physical Chemistry: J. B. Yadav (Goel Publishing House.)
6) Practical Physical Chemistry: B. D. Khosala. (R. Chand & Sons) 7) Experiments in Chemistry: D. V. Jahagirdar.
8) A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed) (ELBS)
9) Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009

| **F) Suggested methods of Teaching:** | |
|---|---|
| i) | Class room teaching |
| ii) | Online teaching in various platform like zoom, Google meet, Microsoft team etc |
| iii) | Collaborative teaching with industrial visit to understand instruments. |
| iv) | Interaction with subject experts to improve basic and advance knowledge about subject. |

| **G) Scheme of Course Evaluation** | | |
|---|---|---|
| **1.** | End Semester Examination (ESE) | 40 |
| **2.** | Continuous Internal Evaluation (CIE) | 10 |
| **3.** | **Total Marks** | **50** |

| **H) Suggested techniques for Continuous Internal Evaluation online / offline ( 10 Marks) (Any one as per condition)** | | |
|---|---|---|
| **1.** | MCQ exam | |
| **2.** | Attendance | |
| **3.** | Home Assignments | |
| **4.** | Industrial Visit | |
| **5.** | Oral | |
| **6.** | Surprise test | |
| **7.** | Open book test | |
| **8** | Seminar | |
| **5.** | **Total Marks** | **10** |

| **I) Question Paper Pattern (40 Marks)** | | |
|---|---|---|
| **Q. No.** | **Nature / Type of Question** | **Marks** |
| **1.** | MCQ (6 Que.) | 06 |
| **2.** | Answer in one sentence (5 Que. 2marks each) | 10 |
| **3.** | Write short note on (attempt any 3 out of 5 Que. 3 marks each) | 12 |
| **4.** | Solve any one out of two | 06 |
| **5.** | Solve any one out of two | 06 |
| **6.** | **Total Marks** | **40** |

**B.Sc. I Syllabus,**

**To be implemented from June 2023 onwards**

**Semester I and II**

**Nature of Practical Exam**

**Semester-I Practical Paper-I (25 Marks)**

**Number of Days: 01**

**First Session:**

Section-I- Inorganic

Q.1 Experiment- 10 Marks

**Second Session:**

Section-II Organic

Q.2 Experiment- 10 Marks

Q.3 Journal- 05 Marks

**Semester-II Practical Paper-II (25 Marks)**

**First Session:**

Section-I- Physical

Q.1 Experiment- 10 Marks

**Second Session:**

Section-II Analytical

Q.2 Experiment- 10 Marks

Q.3 Journal- 05 Marks

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**Shri Acharyaratna Deshbhooshan Shikshan Prasarak Mandal, Kolhapur**

# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

## Affiliated to Shivaji University, Kolhapur

Syllabus for Bachelor of Science

Part– I

Chemistry

**Open Elective (OE)**

(NEP – 2.0)

To be implemented from

June,2024 Onwards

**Bachelor of Science**

**Credit Framework**

**First-Year (B. Sc. I-Chemistry)**

| Level | Sem. | Subject-1 (Chemistry) | Subject-2 | Subject-3 | IDC/MDC/OE/GE | SEC | AEC, VEC, IKS | | | OJT, FP, CEP, CC, RP | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DSC | DSC | DSC | OE | SEC | AEC | VEC | IKS | CC | FP/OJT | RP/ Dissert. | |
| 4.5 | I | ICH-101 Paper-I Inorganic Chemistry (2 Cr) | DSC-I (2 Cr) | DSC-I (2 Cr) | CHOEPR-101 Practical Paper-I Water Analysis (2 Cr) | -- | -- | -- | IKS-I (2 Cr) Introduction to IKS | -- | -- | -- | -- |
| | | OCH-102 Paper-II Organic Chemistry (2 Cr) | DSC-II (2 Cr) | DSC-II (2 Cr) | | | | | | | | | |
| | | PRCH-103 Practical Paper-I (2 Cr) | DSC-P-I (2 Cr) | DSC-P-I (2 Cr) | | | | | | | | | |
| | **Credits** | **4(T)+2(P) =6** | **4(T)+2(P) =6** | **4(T)+2(P) =6** | **2 (P) =2** | **--** | **--** | **--** | **2(T)** | **--** | **--** | **--** | **22** |
| | II | PCH-201 Paper-III Physical Chemistry (2 Cr) | DSC-III (2 Cr) | DSC-I (2 Cr) | CHOEPR-201 Practical Paper-II Soil Analysis (2 Cr) | -- | -- | VEC-I (2 Cr) Democracy, Election and Constitution | -- | -- | -- | -- | -- |
| | | ACH-202 Paper-IV Analytical Chemistry (2 Cr) | DSC-IV (2 Cr) | DSC-II (2 Cr) | | | | | | | | | |
| | | PRCH-203 Practical Paper-II (2 Cr) | DSC-P-II (2 Cr) | DSC-P-II (2 Cr) | | | | | | | | | |
| | **Credits** | **4(T)+2(P)=6** | **4(T)+2(P) =6** | **4(T)+2(P) =6** | **2 (P)=2** | **--** | **--** | **2(T)** | **--** | **--** | **--** | **--** | **22** |
| **Total Credits** | | **12** | **12** | **12** | **4** | **--** | **--** | **2** | **2** | **--** | **--** | **--** | **44** |
| | | **Exit Option: Award of UG Certificate in Major with 44 Credits and an additional 4 credits core NSQF course/ Internship/Skill Courses OR Continue** | | | | | | | | | | | |

**Structure of B. Sc.**

**I**

**OE (CHEMISTRY)**

| Sr. No. | Semester | Title of Paper |
|---|---|---|
| 1 | **I** | CHOEPR-101 Practical Paper-I<br>Water Analysis (2 Cr)<br>(2 credits, 60 Hours) |
| 2 | **II** | CHOEPR-201 Practical Paper-II<br>Soil Analysis (2 Cr)<br>(2 credits, 60 Hours) |

**B. Sc. I (NEP-2.0) Semester I, OE PRACTICAL COURSE PAPER - I**

**CHOEPR-101 – OPEN ELECTIVE (OE) CHEMISTRY**

**(Credits-02, 60 hours)**

**B. Sc. I Semester I, Practical Cour**se
**CHOEPR-101 -PRACTICAL PAPER- I**
**(Credits-02, 60 hours)**

## Expected Course Outcomes:

To learn and understand basic knowledge of physico-chemical properties of water.

To learn about general water quality analysis techniques.

To acquire hands-on skills to perform actual practical analysis in the laboratory.

**Water Analysis:**

**Practicals (Credits-02, 60 hours)**

1. Collection of various water samples.
2. Determination of temperature of water.
3. Determination of pH of various samples using pH meter or pH paper.
4. Determination of electrical conductivity using conductivity meter.
5. Determination of Acidity of water given samples.
6. Determination of Alkalinity of water.
7. Determination of Hardness of water.
8. To measure the dissolved oxygen content in water using a dissolved oxygen test kit.

9. **Water Quality Assessment:** Guiding students through the process of assessing overall water quality based on the results of their tests. They can compare their findings to water quality standards and discuss the implications for human health and the environment.

10. **Field Trips:** Organizing field trips to local water bodies for hands-on observation and testing.

**Reference books**:


1. Chemical and biological method for water pollution; R. K. Trivedi and P. K. Geol, Environ. Pub.
2. Methodology of water analysis; M. S. Kondarkar, IAAB Publication, Hyderabad.
3. Environmental studies; Dr. K. Mukkanti, S. Chand & Camp Ltd.
4. Standard Methods for Examination of water & waste wate APHA-AWWA- WPCE.
5. Manual of water & waste water analysis, NEERI, Nagpur.
6. Text book of water and waste water engineering by H. K. Hussen.
7. Water supply & sanitary engineering by Birdie.
8. Practical methods in ecology & Environmental science by R. K. Trivedi, P. K. Goel, C. L. Trisal.


**B. Sc. I (NEP-2.0) Semester II, OE PRACTICAL COURSE PAPER- II**

**CHOEPR-201 – OPEN ELECTIVE (OE) CHEMISTRY**

**(Credits-02, 60 hours)**

**B. Sc. I Semester II, Practical Cour**se
**CHOEPR-201 -PRACTICAL PAPER- II**
**(Credits-02, 60 hours)**

## Expected Course Outcomes

To learn and understand basic knowledge of physico-chemical properties of soil.

To learn about general soil quality analysis techniques.

To acquire hands-on skills to perform actual practical analysis in the laboratory.

## Soil Analysis

**Practicals: (Credits-02, 60 hours)**

1. Sampling of soil using various soil sampling methods.
2. Determining the acid-base index of various soil samples using a pH meter or paper.
3. Determination of electrical conductivity using conductivity meter.
4. To determine the acidity of the given soil samples. (Acidity)
5. Extraction of coarse sand, fine sand, clay soil etc.
6. Removal of soluble salts from soil
7. Removal of free lime from soil.
8. To check the amount of nutrients such as nitrogen, phosphorus and phosphorus in a given soil sample.
9. Examination of calcium from soil.

10. Soil Quality Assessment: To guide students through the process of assessing overall soil quality based on the results of their tests. They can compare their findings to soil quality standards and discuss the implications for human health and the environment.
11. Field Trips: Conducting field trips to farms for direct observation and testing.

**Reference Books:**


1. Analytical Chemistry-Alka Gupta (Pragati Prakashan)
2. Soil chemicals Analysis - P.R. Hesse
3. Soil testing manual by department of agriculture and cooperation, India
4. Fundamentals of Soil --- V. N. Sahai
5. Text book of Soil science—R. K. Mehra

**B.Sc. I OE CHEMISTRY (NEP-2.0)**

**To be implemented from June 2024 onwards Semester I & II**

**Nature of Practical Exam**

**OE Practical Paper-I/II (50 Marks)**

**Number of Days: 01**

**First Session:**

Section-I

Q.1 Experiment-I - 20 Marks

**Second Session:**

Section-II

Q.2 2 Experiment-II - 20 Marks

Q.3 Journal- 10 Marks

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Shri Acharyaratna Deshbhooshan Shikshan Prasarak Mandal, Kolhapur

# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

## Affiliated to Shivaji University, Kolhapur

Syllabus for Bachelor of Science

Part-II

Chemistry

(NEP-2.0)

To be implemented from

June, 2023 onwards

## Bachelor of Science

## Credit Framework

### First-Year (B. Sc. I-Chemistry)

| Level | Sem. | Subject-1 (Chemistry) | Subject-2 | Subject-3 | IDC/MDC/OE/GE | SEC | AEC, VEC, IKS | | | OJT, FP, CEP, CC, RP | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DSC | DSC | DSC | OE | SEC | AEC | VEC | IKS | CC | FP/OJT | RP/ Dissert. | |
| 4.5 | I | ICH-101 Paper-I Inorganic Chemistry (2 Cr) | DSC-I (2 Cr) | DSC-I (2 Cr) | CHOEPR-101 Practical Paper-I Water Analysis (2 Cr) | -- | -- | -- | IKS-I (2 Cr) Introduction to IKS | -- | -- | -- | -- |
| | | OCH-102 Paper-II Organic Chemistry (2 Cr) | DSC-II (2 Cr) | DSC-II (2 Cr) | | | | | | | | | |
| | | PRCH-103 Practical Paper-I (2 Cr) | DSC-P-I (2 Cr) | DSC-P-I (2 Cr) | | | | | | | | | |
| | **Credits** | **4(T)+2(P) =6** | **4(T)+2(P) =6** | **4(T)+2(P) =6** | **2 (P) =2** | **--** | **--** | **--** | **2(T)** | **--** | **--** | **--** | **22** |
| | II | PCH-201 Paper-III Physical Chemistry (2 Cr) | DSC-III (2 Cr) | DSC-I (2 Cr) | CHOEPR-201 Practical Paper-II Soil Analysis (2 Cr) | -- | -- | VEC-I (2 Cr) Democracy, Election and Constitution | -- | -- | -- | -- | -- |
| | | ACH-202 Paper-IV Analytical Chemistry (2 Cr) | DSC-IV (2 Cr) | DSC-II (2 Cr) | | | | | | | | | |
| | | PRCH-203 Practical Paper-II (2 Cr) | DSC-P-II (2 Cr) | DSC-P-II (2 Cr) | | | | | | | | | |
| | **Credits** | **4(T)+2(P)=6** | **4(T)+2(P) =6** | **4(T)+2(P) =6** | **2 (P)=2** | **--** | **--** | **2(T)** | **--** | **--** | **--** | **--** | **22** |
| **Total Credits** | | **12** | **12** | **12** | **4** | **--** | **--** | **2** | **2** | **--** | **--** | **--** | **44** |
| | | **Exit Option: Award of UG Certificate in Major with 44 Credits and an additional 4 credits core NSQF course/ Internship/Skill Courses OR Continue** | | | | | | | | | | | |

# Structure of B. Sc. I Chemistry

| Sr. No. | Semester | Title of Paper |
|---|---|---|
| 1 | III | Paper-V, Physical Chemistry (2 credits, 30 Hours, 37 Lectures) |
| 2 | | Paper -VI, Industrial Chemistry (2 credits, 30 Hours, 38 Lectures) |
| 3 | | Practical Paper-I (2 credits, 60 Hours) |
| 4 | IV | Paper -VII, Inorganic Chemistry (2 credits, 30 Hours 37 Lectures) |
| 5 | | Paper -VIII, Organic Chemistry (2 credits, 30 Hours 38 Lectures) |
| 6 | | Practical Paper-II (2 credits, 60 Hours) |

Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur

**(New syllabus NEP to be implemented from June, 2023 onwards)**

| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **II** | Semester | **III** |
| Course | **Chemistry** | Course Code | **DSC B1** |
| Paper No. | **V** | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2023 - 24** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **PHYSICAL CHEMISTRY** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | Learning and coherent understanding of conductivity and transport number of the aqueous solutions with different applications. |
| ii) | To understand the physical properties of liquid. |
| iii) | To understand the phase diagrams and derivations of phase equation. |
| iv) | Learning and understanding the knowledge about basic concepts in kinetics and 3rd order reactions. |

| **C) Course Syllabi:**<br>(CR = Credits =02/ IH: Instructional Hours) | |
|---|---|
| **Modules** | **IH** |
| **Module I: Electrolytic Conductivity and Physical Properties of Liquids** | 16 |
| **1. Electrolytic Conductivity**<br><br>1.1 Introduction, | |
| 1.2 Types of conductors, Conductivity, Equivalent and Molar conductivity and their variationwith dilution for weak and strong electrolytes in aqueous solution. | |
| 1.3 Equivalent conductivity at infinite dilution, Measurement of conductance by using Wheatstone bridge. Kolharausch law of independent migration of ions and its applications such as Ionic mobility, | |

| | |
|---|---|
| 1.4 Determination of degree of ionization of weak electrolyte, solubilityand solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of salt. Conductometric titrations (only acid base titrations). | |
| 1.5 Advantages of conductometric titrations. | |
| 1.6 Transference number, Hittorf's rule, determination of transport number using Moving boundary method, factors affecting transport numbers. | |
| 1.7 Numerical problems. | |
| **2. Physical Properties of Liquids** | |
| 2.1 Introduction, | 06 |
| 2.2 Classification of physical properties, Surface tension and its determination using Stalagmometeric and differiential capillary rise methods, | |
| 2.3 Viscosity and its determination using Ostwald's viscometer, Refractive index (Snell's law), | |
| 2.4 Specific and Molecular refractivies and its determination using Abbe's refractometer. | |
| **Module II: Phase Equilibrium, nuclear chemistry and chemical kinetics** | 08 |
| **1. Phase Equilibrium** | |
| 1.1 Phases, components and degrees of freedom of a system, criteria of phase equilibrium. | |
| 1.2 Gibbs Phase Rule and its thermodynamic derivation. | |
| 1.3Phase diagrams of one-component systems (water and sulphur). Two component systems involving eutectics, congruent and incongruent melting points (lead- silver, $FeCl_3$-$H_2O$). | |
| 1.4 Derivation of Clapeyron and Clausius –Clapeyronequatio and its importance in phase equilibria. | |
| **2. Nuclear Chemistry** | 05 |
| 2.1 Introduction, Types of Nuclear radiation, properties of α, β and γ radiations | |
| 2.2 Detection and measurement of nuclear radiations by Scintillation and Geiger muller counter methods, | |
| 2.3 Radioactive equilibrium and range of α- particles, Geiger Nuttal relations, | |
| 2.4 Determination of radioactive constant (decay constant). | |

| | |
|---|---|
| **3. Chemical Kinetics** | 04 |
| 3.1 Introduction, Third order reactions | |
| 3.2Derivation of rate constant, characteristics and examples of third order reaction. | |
| 3.3 Theories of reaction rates as Collision theory and Transition state theory (only quantitative aspect, derivation not expected), | |

| **D) Course Outcomes:** | |
|---|---|
| CO1 | Student gain the knowledge of electrolytic chemistry. |
| CO2 | Students gain the more knowledge about all properties of liquid. |
| CO3 | To understand nuclear radiations and measurements of radiations. |
| CO4 | To gain the knowledge about 3rd order reaction and derivations. |

| **E) Reference Materials** | |
|---|---|
| **E1) Text Books for Reading** | |
| 1. | Phadake |
| 2. | Nirali |
| **E2) Books for Reference** | |
| 1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007). | |
| 2. Castellan G.W. Physical Chemistry 4 th Ed. Narosa (2004). | |
| 3. Kotz, J.C. Treichel, P.M. & Townsend,J.R.General Chemistry, Cengage Learning India Pvt Ltd: NewDelhi (2009). | |
| 4. Mahan,B.H. University Chemistry, 3rd Ed. Narosa (1998). | |
| 5. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co,: New York (1985). | |
| 6. Elements of Physical Chemistry S., Glasstone, D. Lewis.(2010) | |
| 7. Principles of physical Chemistry Marron and Prutton. (2007). | |
| 8. Elements of Physical Chemistry P.W.Atkins (2017) | |
| 9. Essentials of Physical Chemistry Bahl and Tuli. S. Chand, 2010. | |
| 10. Physical Chemistry Danials and Alberty ( 2016) | |
| 11. University General Chemistry C.N.R.Rao (2016) | |
| 12. Principals of Physical Chemistry Puri, Sharma and Pathania 47Th Edison,Vishal Publishing Co. Daryaganj Delhi. 110002 (2017) | |
| 13. Physical Chemistry A.J.Mee.(2015) | |
| 14. Advanced Physical Chemistry Gurudeep Raj (2017) | |
| 15. Physical Chemistry R.A.Aleberty.(2017-18) | |
| 16. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985). | |

Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur

**(New syllabus NEP to be implemented from June, 2023 onwards)**

| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **II** | Semester | **III** |
| Course | **Chemistry** | Course Code | **DSC B2** |
| Paper No. | **VI** | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2022 - 23** |
| Total Credits | **02** | Contact Hours | **03 / Week** |
| Course Title | **INDUSTRIAL CHEMISTRY** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | To understand the scientific techniques of industrial chemistry. |
| ii) | To learn the concept of unit operations. |
| iii) | To understand process of corrosion. |
| iv) | To introduce paper industry or fermentation. |

| **C) Course Syllabi:**<br>(CR = Credits = 02 / IH: Instructional Hours) | |
|---|---|
| **Modules** | **IH** |
| **Module I: Basic Concepts in Industrial Chemistry and unit operation** | 08 |
| **1. Basic Concepts in Industrial Chemistry**<br><br>1.1 The difference between classical chemistry and industrial chemistry, Raw material for the Chemical Industry. | |
| 1.2 Material Safety data sheets, Units that make up a chemical process unit operation and unit processes, Flow Diagrams, Block Diagram, Process flow diagram / flow sheets. | |
| 1.3Material Balances-The purpose of mass balance calculations, Material Balance Equations, Mass balance calculation procedure and simple example. | |
| 1.4 Definition and Explanation of terms -Normality, Equivalent weight, Molality, Molecular weight, Molarity, Molarity of mixed solution, Acidity of base, Basicity of acid, ppt, ppm, ppb solutions. | |
| 1.5 Mole Fraction, Weight fraction, Percentage composition by W/W, W/V, V/V, Problems based on Normality, Molarity, mole fraction, mixed solution, etc. | |
| **2. Unit Operations** | 06 |
| 2.1 Size reduction- Principle, Jaw crusher, ball mill. | |

| | |
|---|---|
| 2.2 Size Enlargement –Principle, Pellet mill, tumbling agglomerators. | |
| 2.3 Separation – Magnetic separation, Froth flotation, Distillation-Distillation of liquid mixtures, Types of distillation, Types of columns and packing, Condensers, Vacuum distillation, Spinning-band distillation, Steam distillation. | |
| **Module II -Corrosion and Electroplating, paper industry and soaps & detergent** | 09 |
| **1. Corrosion and Electroplating** | |
| 1.1 Introduction of corrosion, Electrochemical theory of corrosion. | |
| 1.2 Factors affecting on corrosion - i. Position of metals in the electrochemical series onthe basis of standard reduction potential. ii. Purity of metal. iii. Effect of moisture. iv. Effect of oxygen (differential aeration principle) v. Hydrogen overvoltage, Methods of protections of metals from corrosion. | |
| 1.3 Electroplating: Electrolysis, Faraday's laws, Cathode current Efficiency, Basic principles of electroplating, Cleaning of articles, Electroplating of chromium, Anodising. | |
| **2. Paper Industry** | 06 |
| 2.1 Manufacturing of Pulp, Types of pulp- Sulphate and soda. | |
| 2.2 Manufacturing of paper, calendaring. | |
| 2.3 Ecological problems of Indian Paper industry, Features of good paper industry. | |
| 2.4 Fermentation industries- absolute alcohol, beer, wine and vinegar, citric acid and lactic acid. | |
| 2.4 Modern theory of Aromaticity, Mechanism of Electrophilic substitution reactions: Nitration, Sulphonation, Halogenation and Friedel craft reaction. | |
| **3. Soaps and Detergents** | 07 |
| 3.1 Introduction, Soaps- Raw materials, Types of soaps, Cleansing action of soap. | |
| 3.2 Manufacture of soap- Hot or Cold Process. | |
| 3.3 Detergents - Raw Materials, Types of Detergents: Anionic, cationic and amphoteric, Preparation of Teepol and Deriphat, cleansing action of detergent. | |
| 3.4 Comparisons between soaps and detergents, Application of soap and detergents | |

| D) Course Outcomes: | |
|---|---|
| CO1 | Understand the basic concepts & concentration terms. |
| CO2 | Gained knowledge of some unit operations. |
| CO3 | Able to understand the difference between unit operation & unit process. |
| CO4 | Understand chemical nature & cleansing action of soap. |

| E) Reference Materials |
|---|
| **D1) Text Books for Reading** |
| **1. Phadake** |
| **2. Nirali** |
| **D2) Books for Reference** |
| 3. Industrial chemistry by B.K.Sharma, Goel Publishing Housing, 16th edition2011<br>4. Principles of electroplating and electroforming by Blum and Hogaboom.<br>5. Chemical Process Industries by Shreve and Brink<br>6. Industrial Chemistry by Loutfy Madkor and Helen Njenga |

Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur

**(New syllabus NEP to be implemented from June, 2023 onwards)**

| A) Primary Information: | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **II** | Semester | **III** |
| Course | **Chemistry** | Course Code | **-** |
| Paper No. | **I** | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2022 - 23** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **PRACTICALS IN CHEMISTRY** | | |

B.Sc. II Practical Paper

**Course**

**(Credit: 02, 4 hours per week)**

*A] Physical chemistry:*

1) To study the hydrolysis of methyl acetate in presence of HCl and $H_2SO_4$ and to determine the relative strength of acids.

2) To study the effect of acid strength on hydrolysis of an ester by using
0.5M HCl and 0.25M HCl.

3) To study the reaction rate of hydrolysis of an ethyl acetate by an alkali.

4) To study the reaction between potassium persulphate and Potassium iodide in Solution with unequal concentration of the reactants.

5) To determine the degree of dissociation and dissociation constant of acetic acid at various dilutions and to verify Ostwald's dilution law conductometrically.

6) To determine the normality of the given strong acid by titrating it against the strong alkali conduct metrically.

7) To determine the normality of the given weak acid by titrating it against the strong alkali conductometrically.

8) To determine the percentage composition of a given liquid mixture by viscosity method (Density data to be given).

9) To determine the specific and molar refractions of benzene, toluene and xylene by Abbe's refractometer and to determine the refraction of $CH_2$ Group (Methylene group) (Densities should be determined by students).

10) To determine the specific rotation and unknown concentration of sugar solution.

11) Determination of adsorption coefficient of acetic acid-charcoal system.

*B) Inorganic Chemistry*

1) Inorganic Preparations (Any Two)

1) Preparations of sodium cuprous thiosulphate
2) Preparation of tris (ethylene diamine) nickel (II) thiosulphate
3) Preparation of hexammine nickel (II) chloride 4) Preparation of tetrammine copper (II) sulphate.

2) Titrimetric Analysis (Any Four):

1) Fertilizer analysis: To determine percentage of nitrogen in the given sample of a nitrogenous fertilizer (ammonium sulphate). Known weight of the sample to be taken by the student. For

preparing its solution which is to be refluxed with known excess of alkali. Standard HCl solution to be supplied.

2) Analysis of Synthetic /Commercial Sample: To estimate Magnesium from talcum powder.

3) Determination of alkali content from antacid tablet using HCl solution .

4) Estimation of Calcium from chalk: To estimate amount of calcium from the chalk by titrimetric method. (By redox titration using $KMnO_4$ solution )

5) Determination of total hardness of water using 0.01M EDTA solution.

6) (Students should standardize the given EDTA solution by preparing 0.01M $CaCl_2$ solution. using $CaCO_3$ salt.)

## Reference Books:


1. Khosla, B. D.; Garg, V. C. &Gulati, A.Senior Practical Physical Chemistry, R. Chand & Co: New Delhi (2011).
2. Findlay' Practical Physiccal Chemistry (Longmann) 2015.
3. Practical Physical Chemistry: Gurtu (S Chand) 2014.
4. Systematic Experimental Physical Chemistry: Rajbhoj, Chandekar (Anjali Publication) 2016.
5. Advanced Practical Physical Chemistry: J.B. Yadav (Goel Publishing House) 2015.
6. Physical Chemistry of Inorganic qualitative analysis by Kuricose & Rajar.

Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur

**(New syllabus NEP to be implemented from June, 2023 onwards)**

| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **II** | Semester | **IV** |
| Course | **Chemistry** | Course Code | **DSC B3** |
| Paper No. | **VII** | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2021 - 22** |
| Total Credits | **02** | Contact Hours | **03 / Week** |
| Course Title | **INORGANIC CHEMISTRY** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | The student understands the graphical representation and processing. |
| ii) | Student learns the concept enthalpy and understands enthalpy changes in various chemical processes.<br>Defines effect temperature on enthalpy of reaction, Determines Bond energies from thermochemical data |
| iii) | To understand specific behaviour of gases. |

| **C) Course Syllabi:**<br>(CR = Credits= 02 / IH: Instructional Hours) | |
|---|---|
| **Modules** | **IH** |
| **Module I: Co-ordination Chemistry, Chelation and chemistry of elements of first transition series** | 10 |
| **1. Co-ordination Chemistry**<br><br>1.1 Introduction-Definition and formation of co-ordinate covalent bond in $BF_3$ – $NH_3$[$NH_4$]$^+$ and $H_2O$ | |
| 1.2 Distinguish between double salt and complex salt | |

| | |
|---|---|
| 1.3 Werner's theory-<br>a. Postulates<br>b. The theory as applied to cobalt amines viz. $CoCl_3.6NH_3$, $CoCl_3.5NH_3$, $CoCl_3.4NH_3$, $CoCl_3.3NH_3$ | |
| 1.4 Description of the terms- ligand, co-ordination number, co-ordination sphere, Effective atomicnumber | |
| 1.5 IUPAC nomenclature of coordination compounds.<br><br>1.6 Isomerism in complexes with C.N. 4 and 6<br>c. Geometrical Isomerism<br>d. Optical Isomerism<br>e. Structural Isomerism-Ionisation Isomerism, Hydrate<br>f. Isomerism, CoordinationIsomerism, Linkage<br>g. Isomerism and Co- ordination position Isomerism | |
| 1.7 Valance bond theory of transition metal complex with respect to, C.N. 4, complexes of Cu and Ni C.N. 6 complexes of Fe and Co | |
| **2. Chelation** | 05 |
| 2.1 A brief introduction with respect to ligands, chelating agent, chelation and metal chelates. | |
| 2.2 Structural requirements of chelate formation | |
| 2.3 Difference between metal chelate and metal complex | |
| 2.4 Classification of chelating agents (with specific illustration of bidentate chelating agents) | |
| 2.5 Application of chelation with respect to chelating agents - EDTA and DMG | |
| **3. Chemistry of elements of first transition series.** | 06 |
| 3.1 Position of elements in periodic table | |

| | |
|---|---|
| 3.2 Characteristics of d-block elements with special reference to i) Electronic structure Oxidation states, stability of oxidation states of Fe with respect to<br>Latimer diagram Magnetic character iv) Colored ions v) Complex formation. | |
| **Module II: P- Block elements & Inorganic semi-micro qualitative analysis** | 09 |
| **1. P- Block elements (Group 13, 14 and 15 )**<br><br>1.1 Position of elements in periodic table | |
| 1.2 Characteristics of p-block elements with special reference to electronic configuration and Periodic properties. | |
| 1.3 Compounds of group 13,14 and 15<br>a. Boron-Diborane method of preparation and nature of bonding (structure)<br>b. Borazine method of preparation and nature of bonding (structure)<br>c. Allotropes of carbon and phosphorus | |
| d. Oxyacids of nitrogen – $HNO_2$, $HNO_3$.<br>e. Hydrides of Nitrogen- $NH_3$ and $N_2H_4$ | 08 |
| **2. Inorganic semi-micro qualitative analysis** | |
| 2.1 Theoretical principles involved in qualitative analysis. | |
| 2.2 Applications of solubility product and common ion effect in separation of cations into groups. | |
| 2.3 Application of complex formation in<br>a) Separation of II group into IIA and IIB sub-groups.<br>b) Separation of Copper from Cadmium.<br>c) Separation of Cobalt from Nickel.<br>d) Separation of $Cl^-$, $Br^-$, $I^-$.<br>e) Detection of $NO_2^-$, $NO_3^-$ (Brown ring test). | |
| 2.4 application of oxidation and reduction in<br>f) Separation of $Cl^-$, $Br^-$, $I^-$ in mixture b) Separation of $NO_2^-$ and $NO_3$ in mixture. | |
| 2.5 Spot test analysis. | |

## D) Course Outcomes:

| | |
|---|---|
| CO1 | Students understands and uses the rules and differentiation and integration in chemical derivation. |
| CO2 | Student defines laws of thermodynamics and explains the concept of entropy |
| CO3 | Students able to understand the basic difference with physical phenomenon of gases. |
| CO4 | Gains knowledge about molecularity of reaction, Arrhenius equation, pseudo unimolecular reactions |

| E) Reference Materials |
|---|
| **D1) Text Books for Reading** |
| **1. Phadake** |
| **2. Nirali** |
| **3.** Chemistry for Degree students (B. Sc. First Year): R L Madan (S. Chand and Company) |
| **D2) Books for Reference** |
| |
| 1. Inorganic chemistry, Principles of structure and reactivity by J.E. Huheey and etal |
| 2. Inorganic Chemistry by Shriver and Atkins 5 th edition |
| 3. Vogels text book of Qualitative Inorganic analysis by A. I. Vogel .3 rdand 6th edition |
| 4. Advanced Inorganic Chemistry by Agrawal Keemtilal (Pragati Prakashan) |
| 5. Theoretical Inorganic chemistry by C. Day & J. S. elbin IInd edition |
| 6. Principles of inorganic chemistry by Puri Sharma & Kalia |
| 7. Modern Inorganic chemistry by R. D. Madan (S. Chand) |
| 8. Inorganic Chemistry by J.D. Lee |
| |

9. Basic Inorganic Chemistry by F. A. Cotton, G. Wilkilson & B. L. Gaus wiley
10. Chemistry for Degree students by R. L. Madan (S. Chand Publication)

## Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur

**(New syllabus NEP to be implemented from June, 2023 onwards)**

| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **II** | Semester | **IV** |
| Course | **Chemistry** | Course Code | **DSC B4** |

| Paper No. | **VIII** | Course Type | **Semester** |
|---|---|---|---|
| Total Marks | **50 Marks** | Implementation | **2021 - 22** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **ORGANIC CHEMISTRY** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | To convey the students a thorough basic knowledge of synthetic organic chemistry by studding some selected functional groups. |
| ii) | To understand the basic of reaction and its mechanism. |
| iii) | To be familiarized with the emerging areas of heterocyclic chemistry and their applications in Chemical sciences. |
| iv) | To illustrate chemical structures stereochemistry and chemical reactions |
| v) | To be exposed to the different processes used in industries and their applications. |

| **C) Course Syllabi:**<br>(CR = Credits=02 / IH: Instructional Hours) | |
|---|---|
| **Modules** | **IH** |
| **Module I: Carboxylic acids and their derivatives, amines and diazonium salts** | 08 |
| **1 Carboxylic acids and their derivatives**<br><br>1.1 Monocarboxylic acid: Introduction, IUPAC nomenclature Methods of Formation from Alcohols, Aldehydes, Ketones, Nitriles and Alkyl benzenes.<br>Chemical Reaction: Hell-Vohlard-Zelinsky (HVZ) reaction. | |
| 1.2 Formation of Halo Acids, Mono, Di, Tri- chloro acetic acid. Substitution reaction of Monochloro acetic acid by Nucleophile OH-, I-, CN-and $NH_3$ | |
| 1.3 Hydroxy acids: Malic and Citric acid<br>Methods of formation of Malic acid from maleic acid, from Alpha bromo succinic acid and moist $Ag_2O$. Chemical Reactions: Reactions of Malic acid- Action of heat, oxidation by KMnO4 and reduction reaction with HI. | |
| 1.4 Uses of Malic acid<br>Method of formation of Citric acid from glycerol.<br>Chemical Reactions: Reaction of citric acid: acetylation by acetic anhydride, reduction by HI, action of heat. Uses of citric acid. | |

| | |
|---|---|
| Unsaturated acid: Cinnamic acid: method of formation from benzaldehyde using diethyl malonate and by using acetic anhydride and sodium acetate.<br>Chemical Reactions- Bromination, Oxidation. Uses of cinnamic acid | |

| | |
|---|---|
| Acrylic acid: Method of formation from acrolein and by dehydration of beta hydroxy propionic acid. Chemical Reactions: Addition of water, Reduction by Na/ $C2H_5OH$. Uses of acrylic acid. | |
| 1.5 Dicarboxylic acid: Succinic and phthalic acid<br>Method of formation of succinic acid from ethylene dibromide, maleic acid Chemical Reactions: Action of heat, Action of $NaHCO_3$, $C2H_5OH$ in presence of acid. Uses of succinic acid.<br>Phthalic acid: Method of formation from o-xylene and Naphthalene<br>Chemical Reactions: Action of heat, reaction with sodalime, ammonia, uses of phthalic acid. | |
| 1.6 Carboxylic acid derivatives: Introduction<br>Acid halide derivative: Acetyl chloride: formation from acid, by action with $PCl_3$ and $SOCl_2$, reaction with water, alcohol ( Mechanism of esterification is expected) and ammonia.<br>Uses of acetyl choride.<br>Acid anhydride derivative: Method of formation of acetic anhydride by dehydration of acetic acid, reactions with water, alcohol and ammonia, uses of acetic anhydride. Ester and amide. | |
| **2.Amines and Diazonium Salts:** | 08 |
| 2.1Introduction, Classification, Nomenclature, structure. | |
| 2.2 Methods of preparation: a) From Alkyl halide by Amonolysis, b) By Reduction of Nitriles or Cyanides, c) From Unsubstituted amides (Hoffmann degradation), d) By Gabrial Synthesis (From Phthalamide). | |
| 2.3 Reactions: Carbylamine reaction, Schotten-Baumann reaction, Electrophilic substitution (Aniline), Nitration, Bromination, Sulphonation. | |
| 2.4 Diazonium salt: Introduction, Preparation of diazonium salts. Properties and application of congo red and methyl orange | |

| | |
|---|---|
| 2.5Reactions: Replacement by Halogen(Sandmeyer), Replacement by Iodine, Replacement by –OH, C and N Coupling reactions: Synthesis of Methyl orange and Congo red.Reduction of BDC. | |
| **Module II: Carbohydrates, Carbonyl Compounds- Aldehydes and Ketone and Stereochemistry** | 08 |
| **1. Carbohydrates**<br><br>1.1 Classification of carbohydrates, reducing and non-reducing sugars, General properties ofglucose and fructose, their open chain structure. Reaction of glucose and fructose Epimers, mutarotation and anomers. | |
| 1.2 Determination of configuration of Glucose (Fischer proof). Ring structure of glucose<br>Determination of size of the ring of Glucose by methylation method.<br>Haworth projections. Cyclic structure of fructose. | |
| 1.3 Ascending and descending monosaccharides Linkage between monosaccharides, structure of disacharrides (sucrose, maltose, lactose,<br>Cellobiose) and polysacharrides (starch and cellulose) excluding their structure elucidation. Osazone formation. Shortening carbohydrates with the Wohl degradation. | |
| **2. Carbonyl Compounds- Aldehydes and Ketone** | |
| 2.1 Introduction, Nomenclature, structure. | |
| 2.2 Reactivity of Carbonyl group, mechanism of Nucleophilic addition to Carbonyl group | 06 |
| 2.3 Reactions: mechanism and application of Aldol condensation, Perkin reaction, Cannizaros reaction,Knoevenagel condensation, *Reformatsky* reaction. | |
| **3. Stereochemistry** | |
| 3.1Conformational isomerism – Introduction. | |
| 3.2 Representation of conformations of ethane by using Saw- Horse, Fischer (dotted line wedge) andNewmann's projection formulae. | 08 |
| 3.3 Conformations and conformational analysis of ethane and n-butane by Newmann's Projection formulawith the help of energy profile diagrams. | |
| 3.4 Cycloalkanes relative stability - Baeyer's strain theory, Theory of strainless rings | |

| | |
|---|---|
| 3.5 Conformations and stability of cyclohexane and monosubstituted cyclohexanes Cyclohexanol,bromocyclohexane and methyl cyclohexane.<br>Locking of conformation in t-butyl cyclohexane. | |

## D) Course Outcomes:

| | |
|---|---|
| CO1 | To impart knowledge about the synthesis,reactivity and applications of carboxylic acids. |
| CO2 | Knowledge about classification, preparation and applications of amines and diazoniumsalts. |
| CO3 | Understanding configuration carbohydrates. |
| CO4 | Student will be capable of understanding thenomenclature and reactivity of aldehydes and ketones. |
| CO5 | Student will learn the basic knowledge conformational Analysis of organic compounds. |

## E) Reference Materials

| | |
|---|---|
| **D1) Text Books for Reading** | |
| **1.** | Organic chemistry Bsc II Phadke Publication |
| **2.** | Organic chemistry Bsc II Nirali Publication |
| **D2) Books for Reference** | |
| **1.** | 1 Morrison, R. T. & Boyd, R. N.Organic Chemistry, Dorling Kindersley (India) |
| | Pvt.Ltd.(Pearson Education). |
| **2.** | Stereochemistry conformation & Mechanism, 9th Edition, By P.S.Kalasi, Publisher: New Age International,2017 |
| **3.** | Stereochemistry of carbon compounds by Eliel.. |
| **4.** | Stereochemistry of Organic Compounds by D.Nasipuri. |
| **5.** | Finar, I. L.Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education). |
| **6.** | Finar, I.L. Organic Chemistry (Volume2), Dorling Kindersley (India) Pvt.Ltd. |
| **7.** | Organic Chemistry. Volume I, II, III by S.M.Mukharjee, S.P.Singhand R.P.Kapoor. Wiley Eastern Limited (NewAgeInternational) |
| **8.** | Advanced Organic Chemistry by, B.S.Bahl, Arun Bahl. S.Chand &Company, Ltd |
| **9.** | Chemistry by R.L.Madan, S.Chandand CompanyLtd. |

# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

## Affiliated to Shivaji University, Kolhapur

**(New syllabus NEP to be implemented from June, 2023 onwards)**

**A) Primary Information:**

| | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **II** | Semester | **IV** |
| Course | **Chemistry** | Course Code | **-** |
| Paper No. | **II** | Course Type | **Semester** |
| Total Marks | **25 Marks** | Implementation | **2021 - 22** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **PRACTICALS IN CHEMISTRY** | | |

## A) Organic Chemistry:

1)Organic Qualitative Analysis: Identification of at least Eight Organic compounds with reactions including two from acids, two from phenols, two from bases and two from neutrals.

Acids – Succinic acid, Phthalic acid, alicylic acid, Aspirin. Phenols – AlphaNaphthol, o-nitrophenol, p-nitrophenol. Bases – o, m- and pnitroanilines, Diphenyl amine.

Neutrals – Urea, Acetanilide, Carbon tetrachloride, Bromobenzene, Methyl acetate, Nitrobenzene, Naphthalene, Anthracene, Ethyl methyl ketone.

Note: A systematic study of an organic substance involves reactions in the determination of elements and functional group.

*1) Organic Quantitative Analysis:*

I) Estimations (Any Three)

a. Estimation of acetone.

b. Estimation of vitamin C.

c. Estimation of Phenol by Bromination method

d. Estimation of formaldehyde by sodium sulphite method

e. Estimation of ester.

II) Organic preparations

a. p-nitro acetanilide from acetanilide.

b. Acetanilide from aniline using anhydrous ZnCl2 and Zn dust.

c. Phthalimide from phthalic anhydride.

d. Benzoic acid from benzamide.

2) Demonstration of Thin layer chromatography. Separation, identification and determination of Rf values

## B) Inorganic Chemistry

1 )Gravimetric Analysis (Any two)

i) Gravimetric estimation of iron as $Fe_2O_3$ from a solution containing Ferrous ammonium sulphate and free sulphuric acid.

ii) Gravimetric estimation of barium as $BaSO_4$ from a solution containing barium chloride and free hydrochloric acid.

iii) Gravimetric estimation of nickel as $Ni(DMG)_2$ from a solution containing $NiSO_4.7H_2O$ and free sulphuric acid. iv)Gravimetric estimation of aluminium as Aluminium oxinate from a solution containing aluminium sulphate or potash alum and free sulphuric acid.

2) Semi-micro Qualitative Analysis

Analysis of binary mixtures with non-interfering cations and anions (at least 6 mixtures to be analyzed) v)

Following anions are to be given :

$Cl^-$, $Br^-$, $I^-$, $NO_3^-$, $CO_3^{--}$, $SO_4^{--}$, $S^{--}$, (insoluble $CO_3^{--}$ may be given) vi) Following

cations are to be given :

$Cu^{2+}$, $Cd^{2+}$

$Al^{+3}$, $Fe^{+3}$, $Cr^{+3}$.

$Zn^{+2}$, $Mn^{+2}$, $Ni^{+2}$, $Co^{+2}$, $Ca^{+2}$, $Ba^{+2}$.

$Mg^{+2}$, $NH_4^+$, $K^+$

Note :- Use of spot tests to be made whenever possible.

## Reference Books:


1) Mendham, J.Vogel's Quantitative Chemical Analysis, Pearson 2009.

2) Vogel's text book of Qualitative Inorganic analysis by A. I. Vogel .3rd and 6th edition 3) Vogel's text book of Quantitative Inorganic Chemistry by A. I. Vogel.

4) Practical manual in water Analysis by Goyal & Trivedi 5) Practical Organic Chemistry by A.I. Vogel.

6) Hand book of Organic qualitative analysis by H.T. Clarke.

7) A Laboratory Hand Book of Organic qualitative analysis and separation by V.S. Kulkarni. Dastane Ramchandra& Co.

8) Practical Organic Chemistry by F.G. Mann and B.C. Saunders. Low – priced Text Book. ELBS. Longman 9) Advanced Practical Organic Chemistry by N.K. Vishnoi. Vikas Publishing House Private Limited.

10) Advanced practical chemistry by J. Singh, L. D. S. Yadav, R. K. P. singh, I. R. Siddiqui et.al, Pragati prakashan.


**F) Suggested methods of Teaching:**

| | |
|---|---|
| i) | Class room teaching |
| ii) | Online teaching in various platform like zoom, Google meet, Microsoft team etc iii) Collaborative teaching with industrial visit to understand instruments. |
| iv) | Interaction with subject experts to improve basic and advance knowledge about subject. |

**G) Scheme of Course Evaluation**

| | | |
|---|---|---|
| **1.** | End Semester Examination (ESE) 40 | |
| **2.** | Continuous Internal Evaluation (CIE) 10 | |
| **3.** | **Total Marks 50** | |

| **H) Suggested techniques for Continuous Internal Evaluation online / offline ( 10 Marks) (Any one as per condition)** | | |
|---|---|---|
| **1.** | MCQ exam | |
| **2.** | Attendance | |
| **3.** | Home Assignments | |
| **4.** | Industrial Visit | |
| **5.** | Oral | |
| **6.** | Surprise test | |
| **7.** | Open book test | |
| **8** | Seminar | |
| **5.** | **Total Marks** | **10** |

| **I) Question Paper Pattern (40 Marks)** | | |
|---|---|---|
| **Q. No.** | **Nature / Type of Question** | **Marks** |
| **1.** | MCQ (6 Que.) | 06 |
| **2.** | Answer in one sentence (5 Que. 2marks each) | 10 |
| **3.** | Write short note on (attempt any 3 out of 5 Que. 3 marks each) | 12 |
| **4.** | Solve any one out of two | 06 |
| **5.** | Solve any one out of two | 06 |
| **6.** | **Total Marks** | **40** |

**B.Sc. II Syllabus,**

**To be implemented from June 2023 onwards**

**Semester II and III**

*Nature of Practical Examination*

*Semester-I Practical Paper-I (50 Marks)*

*Number of Days: 02*

*First Session:*

Section-I- Physical

Q.1 Experiment- 25 Marks

*Second Session:*

Section-II Inorganic

Q.1 Experiment- 20 Marks

Q.2 Journal- 05 Marks

*Semester-II Practical Paper-II (50 Marks)*

*First Session:*

Section-I- Organic

Q.1 Experiment- 25 Marks

*Second Session:*

Section-II Inorganic

Q.1 Experiment- 20 Marks

Q.2 Journal- 05 Marks

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**Shri AcharyaratnaDeshbhooshanShikshanPrasarak Mandal, Kolhapur**

# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

## Affiliated to Shivaji University, Kolhapur

## Syllabus for Choice Based Credit System (CBCS) Bachelor of Science (B. Sc.) Programme

| | |
|---|---|
| **Programme** | **Bachelor of Science** |
| **Part** | **III** |
| **Semester** | **V** |
| **Course Code** | |
| **Course Name** | **Chemistry** |
| **Course Title** | **Inorganic Chemistry** |
| **Paper No.** | **IX** |

**Under the Faculty of Science & Technology**

(To be introduced from Academic Year 2023 – 24 onwards)

Subject to the revisions & modifications made from time to time

**Mahavir Mahavidyalaya, Kolhapur (Autonomous)**

**Affiliated to Shivaji University, Kolhapur**

**(New syllabus under Autonomy to be introduced from June, 2021 onwards)**

| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **III** | Semester | **V** |
| Course | | Course Code | **DSE-E5** |
| Paper No. | | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2023 - 24** |
| Total Credits | **02** | Contact Hours | **04/ Week** |
| Course Title | **Inorganic Chemistry** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | To study of Non – aqueous solvents and to learn all chemical properties of solutes and from the research of point view. |
| ii) | To understand geometry, stability and nature of bonding between metal ion and ligand in complex. |
| iii) | To study the synthesis and applications of the semiconductors and superconductors in electrical and electronic devices. |
| iv) | To study the structure , method of preparation and the applications of organometallic compound in various field. |

**C) Course Syllabi:**
(CR = Credits / IH: Instructional Hours)

| **Modules** | **CR** | **IH** |
|---|---|---|
| **Module I: Acids, Bases and Non aqueous solvents** | 02 | 08 |
| 1.1 Introduction to theories of Acids and Bases – Arrhenius concept, Bronsted-Lowry concept , Lux-Flood Concept (definition and example) | | |
| 1.2 Hard and soft Acid and Bases. (HSAB Concept)<br>1.2.1 Classification of acids and bases as hard, soft and borderline. 1.2.2 Pearson's HSAB Concept.<br>1.2.3 Acid-Bases strength and hardness-softness.<br>1.2.4 Applications and limitations of HSAB principle. | | |

| | | |
|---|---|---|
| 1.3 Chemistry of Non aqueous solvents.<br>1.3.1 Introduction ,definition and characteristics of solvents.<br>1.3.2 Classification of solvents.<br>1.3.3 Physical properties and Acid-Bases reactions in Liquid Ammonia ($NH_3$) and Liquid Sulphur Dioxide ($SO_2$) | | |
| **Module II: Metal Ligand bonding in Transition Metal Complexes** | 02 | 05 |
| 2.1 Crystal Field Theory (CFT)<br>2.1.1 Introduction; Shapes of d-orbitals, Basic assumptions of CFT.<br>2.1.2 Crystal field splitting of d-orbitals of metal ion in octahedral ,tetrahedral ,square planer complexes and John–Teller distortion .<br>2.1.3 Factors affecting the Crystal field splitting.<br>2.1.4 High spin and low spin octahedral complexes w.r.t Co(II).<br>2.1.5 Crystal Field stabilization energy (CFSE), Calculation with respect to octahedral complexes only.<br>2.1.6 Limitation of CFT. | | |
| 2.2 Molecular orbital theory (MOT).<br>2.2.1 Introduction.<br>2.2.2 MOT of octahedral complexes with sigma bonding such as $[Ti(H_2O)_6]^{3+}$ , $[CoF_6]^{3-}$ , $[Co(NH_3)_6]^{3+}$ 2.2.3 Merits and demerits of MOT. | | |
| **Module III: Metals, Semiconductors and Superconductors.** | 02 | 09 |
| 3.1 Introduction. | | |
| 3.2 Properties of metallic solids. | | |
| 3.3 Theories of bonding in metal.<br>i. Free electron theory. ii. Molecular orbital theory (Band theory) | | |
| 3.4 Classification of solids as conductor, insulators and semiconductors on the basis of band theory. | | |
| 3.5 Semiconductors Types – intrinsic and extrinsic and applications of semiconductors. | | |
| 3.6 Superconductors: Ceramic superconductors –Preparation and structures of mixed oxide $YBa_2Cu_3O_{7-x}$. | | |

| | | |
|---|---|---|
| 3.7Applications of superconductors. | | |
| **Module IV: Organometallic Chemistry.** | 02 | 08 |
| 4.1 Definition Nomenclature of organometallic compounds. | | |
| 4.2 Synthesis and structural study of alkyl and aryl compounds of Be and Al. | | |
| 4.3 Mononuclear carbonyls – Nature of bonding in simple mononuclear carbonyls. $[Ni(CO)_4]$, $[Fe(CO)_5]$, $[Cr(CO)_6]$. | | |
| **Module V: Catalysis** | 02 | 05 |
| 5.1 Introduction. | | |
| 5.2 Classification of catalytic reaction – Homogeneous and Heterogeneous | | |
| 5.3 Types of catalysis. | | |
| 5.4 Characteristics of catalytic reactions. | | |
| 5.5 Mechanism of catalysis .<br>i. Intermediate compound formation theory .<br>ii. Adsorption theory. | | |
| **5.6** Industrial applications of catalysis. | | |

| **D) Reference Materials** | |
|---|---|
| **D1) Text Books for Reading** | |
| **1.** | Phadake |
| **2.** | Nirali |
| | 1. **D2) Books for Reference** |
| **1.** | Concise Inorganic chemistry (ELBS, 5th Edition)- J. D .Lee |
| **2.** | Inorganic Chemistry (ELBS, 3rd Edition) D. F. Shriver, P. W. Atkins, C. H.Lang Ford, Oxford University Press, 2nd Edition. |
| **3.** | Basic Inorganic Chemistry : Cotton and Wilkinson. |
| **4.** | Advanced Inorganic Chemistry (4th Edn.) Cotton and Wilkinson. |
| **5.** | Concepts and Models of Inorganic Chemistry : Douglas and Mc. Daniel. 3rd Edition. John Wiley publication. |
| **6.** | Structural principles in inorganic compounds. W. E. Addison. |
| **7.** | Theoretical principles of Inorganic Chemistry – G. S. Manku. |
| **8.** | Theoretical Inorganic Chemistry by Day and Selbine. |

| | |
|---|---|
| **9.** | Co-ordination compounds. SFA Kettle. |
| **10.** | Essentials of Nuclear Chemistry by H. J. Arnikar. |
| **11.** | Nuclear Chemistry by M. N. Sastri. |
| **12.** | Organometallic Chemistry by R. C. Mahrotra, A. Sing, Wiley Eastern Ltd.New Delhi. |
| **13.** | Inorganic Chemistry by A. G. Sharpe, Addision – Wisley Longman – Inc. |
| **14.** | Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi. |
| **15.** | Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi. |
| **16.** | Inorganic Chemistry 3rd Edn G. L. Miessler and D.A. Tarr, pearson publication. |
| **17.** | Inorganic Chemistry 3rd Edn G. L. Miessler and D.A. Tarr, pearson publication. |
| **18.** | Co-ordination compounds by Baselo and Pearson. |
| **18** | UGC Inorganic chemistry by H.C. Khera, Pragati prakashan |
| **19** | UGC Advanced Inorganic Chemistry by Agarwal and Keemtilal, Pragati Prakashan |

| **E) Suggested methods of Teaching:** | |
|---|---|
| i) | Class room teaching |
| ii) | Online teaching in various platform like zoom, Google meet, Microsoft team etc |
| iii) | Collaborative teaching with industrial visit to understand instruments. |
| iv) | Interaction with subject experts to improve basic and advance knowledge about subject. |

| **F) Course Outcomes:** | | **Blooms Taxonomy** |
|---|---|---|
| CO1 | Students can understands theory of acid and bases. | |
| CO2 | Student can able to study crystal field theory. | |
| CO3 | Students can understand application semiconductor and superconductor. | |
| CO4 | Gains knowledge about mechanism and application of catalyst. | |

| **G) Scheme of Course Evaluation** | | |
|---|---|---|
| **1.** | End Semester Examination (ESE) | 40 |
| **2.** | Continuous Internal Evaluation (CIE) | 10 |
| **3.** | **Total Marks** | **50** |

| **H) Suggested techniques for Continuous Internal Evaluation online / offline ( 10 Marks) (Any one as per condition)** | | |
|---|---|---|
| **1.** | MCQ exam | |
| **2.** | Attendance | |
| **3.** | Home Assignments | |
| **4.** | Industrial Visit | |
| **5.** | Oral | |

| | | |
|---|---|---|
| **6.** | Surprise test | |
| **7.** | Open book test | |
| **8** | Seminar | |
| **5.** | **Total Marks** | **10** |

| **I) Question Paper Pattern (40 Marks)** | | |
|---|---|---|
| **Q. No.** | **Nature / Type of Question** | **Marks** |
| **1.** | MCQ (6 nos) | 06 |
| **2.** | Answer in short (5nos * 2marks each) | 10 |
| **3.** | Solve any four of six (3 marks each) | 12 |
| **4.** | Solve any one out of two | 06 |
| **5.** | Solve any one out of two | 06 |
| **6.** | **Total Marks** | **40** |

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# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

## Affiliated to Shivaji University, Kolhapur

**(New syllabus under Autonomy to be introduced from June, 2021 onwards)**

| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **III** | Semester | **V** |
| Course | | Course Code | **DSE-E6** |
| Paper No. | | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2023 - 24** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **Organic chemistry** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | To understand the basics of industrial chemistry. |

| | |
|---|---|
| ii) | To learn manufacturing processes of heavy chemicals. |
| iii) | To understand basic concepts of spectroscopy. |
| iv) | To introduce molecular structures by using spectroscopic techniques. |

## C) Course Syllabi:

(CR = Credits / IH: Instructional Hours)

| Modules | CR | IH |
|---|---|---|
| **Module1. Introduction to Spectroscopy** | 02 | **03** |
| 1.1 Meaning of spectroscopy.<br>1.2 Nature of electromagnetic radiation: wavelength, frequency, energy, amplitude, wave number and their relationship.<br>1.3 Different units of measurement of wavelength and frequency.<br>1.4 Different regions of electromagnetic radiations.<br>1.5 Interaction of radiation with matter: absorption, emission, fluorescence and scattering.<br>1.6 Types of spectroscopy and advantages of spectroscopic methods.<br>1.7 Energy types and energy levels of atoms and molecules. | | |
| **Module 2. UV-Vis Spectroscopy** | 02 | 05 |

| | | |
|---|---|---|
| 2.1 Introduction.<br><br>2.2 Beer-Lambert's law, absorption of UV radiation by organic molecules leading to different excitations.<br><br>2.3 Terms used in UV Spectroscopy: Chromophore, Auxochrome, Bathochromic shift, hypsochromic shift, hyperchromic and hypochromic effect.<br><br>2.4 Modes of electromagnetic transitions.<br><br>2.5 Effect of conjugation on position of UV band.<br><br>2.6 Calculation of λmax by Woodward and Fischer rules for dienes and enones.<br><br>2.7 Colour and visible spectrum.<br><br>2.8 Applications of UV Spectroscopy. | | |

| **Module 3. IR Spectroscopy** | 02 | 06 |
|---|---|---|
| 3.1 Introduction.<br><br>3.2 Principles of IR Spectroscopy.<br><br>3.3 Instrumentation, schematic diagram.<br><br>3.4 Fundamental modes of vibrations, types and calculation.<br><br>3.5 Conditions for absorption of IR radiations.<br><br>3.6 Regions of IR spectrum, fundamental group region, finger print region.<br><br>3.7 Hook's Law for Calculation of vibrational frequency.<br><br>3.8 Factors affecting IR absorption frequency. 16<br><br>3.9 Characteristic of IR absorption of following functional groups<br><br>a) alkanes, alkenes, alkynes b) alcohol and phenols c) ethers<br><br>d) carbonyl compounds e) amines f) nitro compounds and g) aromatic compounds. | | |

| | | |
|---|---|---|
| **Module 4. NMR Spectroscopy** | 02 | 09 |
| 4.1 Introduction.<br>4.2 Principles of PMR Spectroscopy.<br>4.3 NMR- Instrumentation, Schematic diagram.<br>4.4 Magnetic and nonmagnetic nuclei.<br>4.5 Chemical shift: definition, measurement, calculation, Factors affecting Chemical shift.<br>4.6 Shielding &deshielding.<br>4.7 Peak Integration.<br>4.8 Merits of TMS as PMR reference compound.<br>4.9 Coupling Constant. | | |
| 4.10 Types of Coupling Constant.<br>4.11 Spin-spin splitting (n+1 rule).<br>4.12 Applications. | | |
| **Module 5. Mass Spectroscopy** | 02 | 08 |

| | | |
|---|---|---|
| 5.1 Introduction.<br>5.2 Principles of mass spectroscopy.<br>5.3 Mass spectrometer - schematic diagram.<br>5.4 Types of ions produced during fragmentation.<br>5.5 Nitrogen rule.<br>5.6 Fragmentation patterns of: alkanes, alkenes, aromatic hydrocarbons, alcohols, phenols, amines and carbonyl compounds.<br>5.7 McLaffrety rearrangement.<br>5.8 Applications. | | |
| **Module 6. Combined Problems based on UV, IR, NMR and Mass Spectral data.** | 02 | 07 |

## D) Reference Materials

### D1) Text Books for Reading

| | |
|---|---|
| 1. | Phadake |
| 2. | Nirali |

### D2) Books for Reference

| | |
|---|---|
| 1. | Absorption Spectroscopy of Organic Molecules by V.M.Parikh. |
| 2. | Spectroscopy of Organic compounds by P. S. Kalsi. |
| 3. | Elementary Organic Absorption Spectroscopy by Y. R. Sharma. |
| 4. | Instrumental Methods of Analysis (7th edition) by Willard, Merritt, Dean, Settle. |
| 5. | Spectroscopy by G. R. Chatwal and S. K. Anand. |
| 6. | Spectroscopy by Pavia, lampman, Kriz,Vyvyan. |

| | |
|---|---|
| 7. | Organic Spectroscopy (2nd edition) by JagMohan. |
| 8. | Organic Spectroscopy (3rd edition) by William Kemp. |
| 9. | Instrumental Methods of Chemical Analysis by H. Kaur. |

## E) Suggested methods of Teaching:

| | |
|---|---|
| i) | Class room teaching |
| ii) | Online teaching in various platform like zoom, Google meet, Microsoft team etc |
| iii) | Collaborative teaching with industrial visit to understand instruments. |
| iv) | Interaction with subject experts to improve basic and advance knowledge about subject. |

| **F) Course Outcomes:** | | **Blooms Taxonomy** |
|---|---|---|
| CO1 | Understanding of energy associated with electromagnetic radiation & its use in analytical technique. | |
| CO2 | Knowledge of chromophore, auxochrome & calculation of $\lambda_{max}$. | |
| CO3 | Knowledge of vibrational transition, regions of IR spectrum, functional group recognition. | |
| CO4 | Understanding of magnetic-non magnetic nuclei, shielding-deshielding, chemical shift, splittimg pattern. | |

| **G) Scheme of Course Evaluation** | | |
|---|---|---|
| **1.** | End Semester Examination (ESE) | 40 |
| **2.** | Continuous Internal Evaluation (CIE) | 10 |
| **3.** | **Total Marks** | **50** |

| **H) Suggested techniques for Continuous Internal Evaluation online / offline ( 10 Marks) (Any one as per condition)** | | |
|---|---|---|
| **1.** | MCQ exam | |
| **2.** | Attendance | |
| **3.** | Home Assignments | |
| **4.** | Industrial Visit | |
| **5.** | Oral | |
| **6.** | Surprise test | |
| **7.** | Open book test | |
| **8** | Seminar | |
| **5.** | **Total Marks** | **10** |

| I) Question Paper Pattern (40 Marks) | | |
|---|---|---|
| **Q. No.** | **Nature / Type of Question** | **Marks** |
| **1.** | Answer in one sentence. (4 que 1 mark each) | 04 |
| **2.** | MCQ. | 04 |
| **3.** | Solve any two out of three. (8 mark each) | 16 |
| **4.** | Solve any four out of six. (4 mark each) | 16 |
| **5.** | **Total Marks** | **40** |

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# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

**Affiliated to Shivaji University, Kolhapur**

**(New syllabus under Autonomy to be introduced from June, 2021 onwards)**

| A) Primary Information: | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **III** | Semester | **V** |
| Course | | Course Code | **DSE-E7** |
| Paper No. | **XI** | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2023 - 24** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **Physical chemistry** | | |

**B) Course Objectives:**

| | |
|---|---|
| i) | Learning and understanding quantum Chemistry, Heisenberg's uncertainty principle, concept of energy operators (Hamiltonian), learning of Schrodinger wave equation. Physical interpretation of the $\psi$ and $\psi 2$ . Particle in a one dimensional box |
| ii) | Knowledge about spectroscopy, Electromagnetic spectrum, Energy level diagram, Study of rotational spectra of diatomic molecules: Rigid rotor model, Microwave oven, vibrational spectra of diatomic molecules, simple Harmonic oscillator model, Raman spectra: Concept of polarizability, pure rotational and pure Vibrational Raman spectra of diatomic molecules, related knowledge will be gained by the students. |

| | |
|---|---|
| iii) | Learning and understanding photochemical laws, reactions and various photochemical phenomena. |
| iv) | Learning the various types of solutions, relations vapour pressure, temperature relations. |

## C) Course Syllabi:

(CR = Credits / IH: Instructional Hours)

| Modules | CR | IH |
|---|---|---|
| **Module1. Elementary quantum mechanics** | 02 | 08 |
| 1.1 Introduction.<br>1.2 Drawbacks of classical mechanics, Black body radiation, Photoelectric effect, Compton effect, Duel nature of matter and energy: De Broglie hypothesis. 1.3 The Heisenberg's uncertainty principle.<br>1.4 Concept of energy operators (Hamiltonian).<br>1.5 Derivation of Schrodinger wave equation, well behaved function.<br>1.6 Physical interpretation of the ψ and ψ2 .<br>1.7 Particle in a one dimensional box. 1.8 Numerical problems. | | |
| **Module 2. Spectroscopy** | 02 | 06 |
| 2.1 Introduction.<br>2.2 Electromagnetic radiation.<br>2.3 Interaction of radiation with matter, Electromagnetic spectrum, Energy level diagram.<br>2.4 Rotational spectra of diatomic molecules: Rigid rotor model, moment of inertia, energy levels of rigid rotor, selection rules, Intensity of spectral lines, determination of bond length, isotope effect, Microwave oven<br>2.5 Vibrational spectra of diatomic molecules: Simple Harmonic oscillator model, Vibrational energies of diatomic molecules, Determination of force constant, overtones.<br>2.6 Raman spectra: Concept of polarizability, pure rotational and pure Vibrational Raman spectra of diatomic molecules, selection rules.<br>2.7 Comparative study of IR and Raman spectra, rule of mutual | | |

| | | |
|---|---|---|
| exclusion- $CO_2$ molecule.<br>2.8 Numerical problems. | | |
| **Module 3. Photochemistry** | 02 | 06 |
| 3.1 Introduction, Difference between thermal and photochemical processes.<br>3.2 Laws of photochemistry: i) Grotthus - Draper law ii) Lambert law iii) Lambert – Beer's law (with derivation) iv) Stark-Einstein law.<br>3.3 Quantum yield, Reasons for high and low quantum yield.<br>3.4 Factors affecting Quantum yield.<br>3.5 Photosensitized reactions – Dissociation of $H_2$, Photosynthesis.<br>3.6 Photodimerisation of anthracene, decomposition of HI and HBr.<br>3.7 Jablonski diagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence.<br>3.8 Chemiluminescence, Electroluminescence and Bioluminescence.<br>3.9 Numerical problems. | | |
| **Module 4. Solutions** | 02 | 06 |
| 4.1 Introduction.<br>4.2 Ideal solutions, Raoult's law, Vapour pressure of ideal and non ideal solutions of miscible liquids.<br>4.3 Composition of liquid and vapour, vapour pressure and boiling point diagrams of miscible liquids. Distillation of miscible liquid pairs. Type I : Systems with intermediate total vapour pressure (i.e. System in which b.p. increases regularly – Zeotropic). Type II : Systems with a maximum in the total vapour pressure (i.e. System with a b.p. minimum – Azeotropic). Type III : Systems with a minimum in the total vapour pressure (i.e. System with a b.p. Maximum – Azeotropic).<br>4.4 Solubility of partially miscible liquids. i. Maximum solution temperature type: Phenol – water system. ii. Minimum solution temperature type: Triethyl amine – water system. iii. Maximum and minimum solution temperature type: Nicotine – water system.<br>Distillation of partially miscible liquid pairs.<br>4.5 Vapour pressure and distillation of immiscible liquids, steam distillation. | | |
| **Module 5. Electromotive force** | 02 | 10 |
| 5.1 Introduction<br>5.2 Thermodynamics of electrode potentials, Nernst equation for electrode and cell potentials in terms of activities.<br>5.3 E.M.F. series. | | |

| | | |
|---|---|---|
| 5.4 Types of electrodes: Description in terms of construction, representation, half cell reaction and emf equation for i) Metal – metal ion electrode. ii) Amalgam electrode. iii) Metal – insoluble salt electrode. iv) Gas – electrode. v) Oxidation – Reduction electrode.<br>5.5 Reversible and Irreversible cells. i. Chemical cells without transference. ii. Concentration cells with and without transference. iii. Liquid – Liquid junction potential: Origin, elimination and determination.<br>5.6 Equilibrium constant from cell emf, Determination of the thermodynamic parameters such as $\Delta G$, $\Delta H$ and $\Delta S$.<br>5.7 Applications of emf measurements : i. Determination of pH of solution using Hydrogen electrode. ii. Solubility and solubility product of sparingly soluble salts (based on concentration cells).<br>5.8 Numerical problems. | | |

## D) Reference Materials

### D1) Text Books for Reading

| | |
|---|---|
| **1.** | **Phadake** |
| **2.** | **Nirali** |

### D2) Books for Reference

| | |
|---|---|
| 1. | Physical Chemistry by G. M. Barrow, International student Edition,Mc Graw Hill. |
| 2. | University General Chemistry by C.N.R. Rao, Macmillan. |
| 3. | Physical Chemistry by, R. A. Alberty, Wiley Eastern Ltd. |
| 4. | The Elements of Physical Chemistry by P. W. Atkins, Oxford. |
| 5. | Principles of Physical Chemistry by S. H. Maron, C. H. Prutton, 4thE dition |
| 6. | Nuclear and Radiochemistry by Friedlander, Kennedy and Miller, John Wiley and Sons. Wiley International edition. |
| 7. | Essentials of Nuclear Chemistry by H. J. Arnikar, 4th edition. Wiley Eastern. |
| 8. | Principles of Physical Chemistry by Puri, Sharma, Pathania,Shobhanlal Naginchand and Company, Jalandar. |
| 9. | Instrumental methods of chemical analysis by Chatwal and Anand,5th Edition, Himalaya Publication. |
| 10. | Fundamentals of molecular spectroscopy by C. N. Banwell – Tata Mc Graw-Hill. |
| 11. | Quantum Chemistry including molecular spectroscopy by B. K. Sen,Tata Mc Graw -Hill. |
| 12. | Text Book of Physical Chemistry by S. Glasstone, Macmillan India Ltd. |
| 13. | Elements of Physical Chemistry by D. Lewis and S. Glasstone (Macmillan). |
| 14. | Principles of Physical Chemistry by Maron and Lando (Amerind). |
| 15. | Electrochemistry by S. Glasstone |

| | |
|---|---|
| 16. | Physical Chemistry by W. J. Moore. |
| 17. | Basic Chemical Thermodynamics by V. V. Rao (Macmillan). |
| 18. | Essential of Physical Chemistry, Bahl and Tuli (S. Chand). |
| 19. | Text Book of Physical Chemistry, Soni and Dharmarha. |
| 20. | Advanced Physical Chemistry Gurdeep Raj GOEL Publishing House, 36th Edition |

| **E) Suggested methods of Teaching:** | |
|---|---|
| i) | Class room teaching |
| ii) | Online teaching in various platform like zoom, Google meet, Microsoft team etc |
| iii) | Collaborative teaching with industrial visit to understand instruments. |
| iv) | Interaction with subject experts to improve basic and advance knowledge about subject. |

| **F) Course Outcomes:** | | **Blooms Taxonomy** |
|---|---|---|
| CO1 | Learning and understanding quantum Chemistry, Heisenberg's uncertainty principle, concept of energy operators (Hamiltonian), learning of Schrodinger wave equation. Physical interpretation of the $\psi$ and $\psi 2$ . Particle in a one dimensional box | |
| CO2 | Knowledge about spectroscopy, Electromagnetic spectrum, Energy level diagram, Study of rotational spectra of diatomic molecules: Rigid rotor model, Microwave oven, vibrational spectra of diatomic molecules, simple Harmonic oscillator model, Raman spectra: Concept of polarizability, pure rotational and pure Vibrational Raman spectra of diatomic molecules, related knowledge will be gained by the students. | |
| CO3 | Learning and understanding photochemical laws, reactions and various photochemical phenomena. | |
| CO4 | Learning the various types of solutions, relations vapour pressure, temperature relations. | |

| **G) Scheme of Course Evaluation** | | |
|---|---|---|
| **1.** | End Semester Examination (ESE) | 40 |
| **2.** | Continuous Internal Evaluation (CIE) | 10 |
| **3.** | **Total Marks** | **50** |

| **H) Suggested techniques for Continuous Internal Evaluation online / offline ( 10 Marks) (Any one as per condition)** | | |
|---|---|---|
| **1.** | MCQ exam | |
| **2.** | Attendance | |

| | | |
|---|---|---|
| **3.** | Home Assignments | |
| **4.** | Industrial Visit | |
| **5.** | Oral | |
| **6.** | Surprise test | |
| **7.** | Open book test | |
| **8** | Seminar | |
| **5.** | **Total Marks** | **10** |

| **I) Question Paper Pattern (40 Marks)** | | |
|---|---|---|
| **Q. No.** | **Nature / Type of Question** | **Marks** |
| **1.** | Answer in one sentence. (4 que 1 mark each) | 04 |
| **2.** | MCQ. | 04 |
| **3.** | Solve any two out of three. (8 mark each) | 16 |
| **4.** | Solve any four out of six. (4 mark each) | 16 |
| **5.** | **Total Marks** | **40** |

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# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

**Affiliated to Shivaji University, Kolhapur**

**(New syllabus under Autonomy to be introduced from June, 2021 onwards)**

| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **III** | Semester | **V** |
| Course | | Course Code | **DSE-E8** |
| Paper No. | | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2023 - 24** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **Analytical chemistry** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | To understand the scientific techniques of industrial chemistry. |
| ii) | To learn the basics of chromatography**.** |
| iii) | To understand quality control practices in analytical industries. |
| iv) | To introduce gravimetric analysis. |

**C) Course Syllabi:**
(CR = Credits / IH: Instructional Hours)

| **Modules** | **CR** | **IH** |
|---|---|---|
| **Module 1. Theory of Gravimetric Analysis** | 02 | **08** |
| 1.1 Introduction.<br>1.2 Gravimetric analysis by precipitation: nucleation, crystal growth, digestion/ageing, filtration, drying, ignition, weighing.<br>1.3 Optimum conditions for good precipitation.<br>1.4 Physical nature of precipitate.<br>1.5 Purity of precipitate: co-precipitation, post-precipitation.<br>1.6 Organic precipitants and their applications. | | |
| **Module 2. Flame Photometry** | 02 | 06 |

| | | |
|---|---|---|
| 2.1 Introduction.<br><br>2.2 General principles of flame photometry.<br><br>2.3 Instrumentation: Block diagram, Burners (Premix and Lundergraph burners), mirror, slits, filters, detector (Photomultiplier tube).<br><br>2.4 Effect of solvent in flame photometry.<br><br>2.5 Experimental procedure of analysis (Standard addition and internal standard).<br><br>2.6 Interferences and Factors that influence the intensity of emitted radiation in a flame photometer.<br><br>2.7 Applications of flame photometry in real sample analysis.<br><br>2.8 Limitations of flame photometry. | | |

| | | |
|---|---|---|
| **Module 3. Colorimetry and Spectrophotometry** | 02 | 06 |

| | | |
|---|---|---|
| 3.1 Theory of colorimetry and spectrophotometry.<br>3.2 Lambert Beer's law, deviation from Beer's law.<br>3.3 Terms used in colorimetry and spectrophotometry.<br>3.4 Classification of methods of 'colour' measurement or comparison.<br>3.5 Photoelectric colorimeter method–Single beam photo-electric colorimeter.<br>3.6 Spectrophotometer method–Single beam direct reading spectrophotometer.<br>3.7 Determination of unknown concentration by using concentrationabsorbance plot.<br>3.8 Applications of colorimetry and spectrophotometry. | | |
| **Module 4. Potentiometric titrations** | 02 | 07 |
| 4.1 Introduction.<br>4.2 Determination of pH.<br>4.3 Study of Quinhydrone and Glass electrodes and their use in determination of pH.<br>4.4 Potentiometric titrations: Classical and analytical methods for locating end points.<br>4.5 Acids- Bases titration with suitable example.<br>4.6 Redox titration with suitable example.<br>4.7 Precipitation titration with suitable example.<br>4.8 Basic circuit of direct reading potentiometer. | | |

| | | |
|---|---|---|
| 4.9 Advantages of potentiometric titrations. | | |
| **Module 5. Chromatographic techniques and Quality control** | 02 | 10 |
| 5.1 Introduction, classification.<br><br>5.2 Column chromatography: Introduction, types, Principle of adsorption column chromatography, solvent system, stationary phases, Methodology-Column packing, applications of sample, development, detection methods, recovery of components, Applications.<br><br>5.3 Ion exchange chromatography: Introduction, Principle, Types and properties of ion exchangers, Methodology-Column packing, application of sample, elution, detection/analysis, Applications.<br><br>5.4 Concepts in Quality control i. Introduction and Concept of quality.<br><br>ii. Quality control. iii. Quality assurance. iv. ISO series.<br><br>v. Good laboratory practice | | |

## D) Reference Materials

### D1) Text Books for Reading

| | |
|---|---|
| 1. | Phadake |
| 2. | Nirali |

| | |
|---|---|
| **D2) Books for Reference** | |
| 1. | Text Book of Quantitative inorganic analysis – A.I.Vogel. |
| 2. | Instrumental methods of chemical analysis –Willard, Merit & Dean. |
| 3. | Vogel's textbook of qualitative inorganic analysis – Bassett, Denny etc. |
| 4. | Textbook of qualitative inorganic analysis – Kolthoff and Sandel. |
| 5. | Fundamentals of analytical chemistry – Skoog and West. |
| 6. | Basic concepts of analytical chemistry – S.M. Khopkar. 8. Text book of qualitative chemical analysis – Vogel. |
| 7. | Handbook of quality assurance for the analytical chemistry laboratory – James P.Dux,Van Nostrand Reinhold,New York 1986. |
| 8. | Instrumental methods of chemical analysis – H.Kaur. |
| 9. | A text book of Quantitative chemical analysis Vogel's by J.Mendham, R. C. Denney. |
| 10. | Quantitative Chemical Analysis – Daniel C. Harris. |
| 11 | Applying ISO 9000 Quality management system, International trade centre publishing genera, Indian edition printed by D. L. Shaha Trust. |
| 12. | Instrumental methods of chemical analysis – Chatwal & Anand. |
| 13. | Textbook of qualitative chemical analysis – Vogel. |

| **E) Suggested methods of Teaching:** | |
|---|---|
| i) | Class room teaching |
| ii) | Online teaching in various platform like zoom, Google meet, Microsoft team etc |
| iii) | Collaborative teaching with industrial visit to understand instruments. |

| | |
|---|---|
| iv) | Interaction with subject experts to improve basic and advance knowledge about subject. |

| **F) Course Outcomes:** | | **Blooms Taxonomy** |
|---|---|---|
| CO1 | Understand the techniques of gravimetric analysis. | |
| CO2 | Knowledge of instrumental analysis. | |
| CO3 | Understanding, working & application of optical methods. | |
| CO4 | Understanding theory & application of potentiometric titration. | |

| **G) Scheme of Course Evaluation** | | |
|---|---|---|
| **1.** | End Semester Examination (ESE) | 40 |
| **2.** | Continuous Internal Evaluation (CIE) | 10 |
| **3.** | **Total Marks** | **50** |

| **H) Suggested techniques for Continuous Internal Evaluation online / offline ( 10 Marks) (Any one as per condition)** | | |
|---|---|---|
| **1.** | MCQ exam | |
| **2.** | Attendance | |
| **3.** | Home Assignments | |
| **4.** | Industrial Visit | |
| **5.** | Oral | |
| **6.** | Surprise test | |
| **7.** | Open book test | |
| **8** | Seminar | |
| **5.** | **Total Marks** | **10** |

| **I) Question Paper Pattern (40 Marks)** | | |
|---|---|---|
| **Q. No.** | **Nature / Type of Question** | **Marks** |
| **1.** | Answer in one sentence. (4 que 1 mark each) | 04 |
| **2.** | MCQ. | 04 |
| **3.** | Solve any two out of three. (8 mark each) | 16 |
| **4.** | Solve any four out of six. (4 mark each) | 16 |
| **5.** | **Total Marks** | **40** |

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**Shri AcharyaratnaDeshbhooshanShikshanPrasarak Mandal, Kolhapur**

# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

## Affiliated to Shivaji University, Kolhapur

## Syllabus for Choice Based Credit System (CBCS) Bachelor of Science (B. Sc.) Programme

| | |
|---|---|
| **Programme** | **Bachelor of Science** |

| | |
|---|---|
| **Part** | **III** |
| **Semester** | **VI** |
| **Course Code** | |
| **Course Name** | **Chemistry** |
| **Course Title** | **Inorganic Chemistry** |
| **Paper No.** | **XIII** |

**Under the Faculty of Science & Technology**
(To be introduced from Academic Year 2023 – 24 onwards)
Subject to the revisions & modifications made from time to time

# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

**Affiliated to Shivaji University, Kolhapur**

**(New syllabus under Autonomy to be introduced from June, 2021 onwards)**

| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **III** | Semester | **VI** |
| Course | | Course Code | **DSE-E6** |
| Paper No. | | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2023 - 24** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **Inorganic Chemistry** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | To understand $SN_1$ and $SN_2$ reactions for inert and labile complexes. |
| ii) | To study trans effect and its theories. |
| iii) | To understand nuclear reactions and energetic of nuclear reactions. |
| iv) | To study concept of chemistry of f- Block elements |

**C) Course Syllabi:**
(CR = Credits / IH: Instructional Hours)

| Modules | CR | IH |
|---|---|---|
| **Module1. Coordination Chemistry** | **02** | **12** |
| **1.1 A] Inorganic Reaction mechanism –** 1.1.1 Introduction. | | |
| 1.1.2 Classification of Mechanism: Association, dissociation, interchange and the rate determining steps. | | |
| 1.1.3 $SN_1$ and $SN_2$ reactions for inert and labile complexes. | | |
| 1.1.4 Mechanism of substitution in cobalt (III) octahedral complexes. | | |
| 1.1.5 Trans effect and its theories. | | |
| 1.1.6 Applications of trans effect in synthesis of Pt (II) complexes. | | |
| 1.2 **B] Thermodynamic and Kinetic aspects of metal complexes-**<br>1.2.1 Introduction.<br>1.2.2 Thermodynamic stability. | | |
| 1.2.3 Kinetic Stability. | | |
| 1.2.4 Relation between thermodynamic and kinetic stability. | | |
| 1.2.5 Stepwise stability constant. | | |
| 1.2.6 Factor affecting the stability of complexes. | | |
| 1.2.7 Determination of Stability constant by Job variation, Mole ratio and Slope ratio method. | | |
| **Module 2. Nuclear Chemistry** | **02** | **05** |
| 2.1 Nuclear reactions and energetic of nuclear reactions. | | |

| | | |
|---|---|---|
| 2.2 Types of nuclear reactions - i. Artificial transmutation. ii. Artificial radioactivity. iii. Nuclear fission and its application in heavy water nuclear reactor. iv. Nuclear fusion. | | |
| 2.3 Use of Thorium, Uranium and Plutonium in atomic energy. | | |

| | | |
|---|---|---|
| 2.4 Applications of radio-isotopes as tracers- i) Chemical investigation – Esterification. ii. Structural determination – Phosphorus pentachloride. iii. Analytical Chemistry – Isotopic dilution method for determination of volume of blood. iv. Age determination – Dating by C14. | | |
| **Module 3. Chemistry of f- Block Elements** | **02** | **08** |
| 3.1 **A] Lanthanides**- 3.1.1 Introduction. | | |
| 3.1.2 Occurrence. | | |
| 3.1.3 Electronic Configuration. | | |
| 3.1.4 Oxidation State. | | |
| 3.1.5 Lantahnide contraction. | | |
| 3.1.6 Separation of Lanthanides by Ion exchange method. | | |
| 3.2 **B] Actinides** – 3.2.1 Position in periodic table. | | |
| 3.2.2 Electronic configuration. | | |
| 3.2.3 General methods of preparation of transuranic elements. i. Neutron capture – followed by β decay. ii. Accelerated projectile bombardment. iii. Heavy ion bombardment. | | |
| 3.2.4 IUPAC nomenclature of the super heavy elements with atomic number (Z) greater than 100. | | |
| **Module 4. Iron and Steel.** | **02** | **07** |
| 4.1 Occurrence and ores of iron. | | |
| 4.2 Definition of the Terms- Ore, Mineral, Slag, Flux, Gangue, Matrix, Calcinations, Reduction, Roasting, Smelting and Leaching. | | |
| 4.3 Extraction of iron by Blast furnace. | | |
| 4.4 Steel: Definition and types. | | |
| 4.5 Conversion of cast iron into steel by i. Bessemer process. ii. L.D. process. | | |

| | | |
|---|---|---|
| 4.6 Heat treatment on steel. | | |
| **Module 5. Bio-inorganic Chemistry.** | **02** | **05** |
| 5.1 Introduction. | | |
| 5.2 Essential and trace elements in biological process. | | |
| 5.3 Metalloporphyrins with special reference to hemoglobin and myoglobin. | | |
| 5.4 Biological role of alkali and alkaline earth metal ions with special referenc to Na+ , K+ and Ca2+ | | |

| **D) Reference Materials** | |
|---|---|
| **D1) Text Books for Reading** | |
| 1. | Phadake |
| 2. | Nirali |
| **D2) Books for Reference** | |
| 1. | Concise Inorganic Chemistry (ELBS, 5th Edition) – J. D. Lee. |
| 2. | Inorganic Chemistry (ELBS, 3rd Edition) D. F. Shriver, P. W. Atkins, C. H.Lang Ford, Oxford University Press, 2nd Edition. |
| 3. | Basic Inorganic Chemistry : Cotton and Wilkinson. |
| 4. | Advanced Inorganic Chemistry (4th Edn.) Cotton and Wilkinson. |
| 5. | Structural principles in inorganic compounds. W. E. Addison. |
| 6. | Theoretical principles of Inorganic Chemistry – G. S. Manku. |
| 7. | Theoretical Inorganic Chemistry by Day and Selbine. |
| 8. | Organometallic Chemistry by R. C. Mahrotra A. Sing, Wiley Eastern Ltd.New Delhi. |
| 9. | Inorganic Chemistry by A. G. Sharpe, Addision – Wisley Longman – Inc. |
| 10. | Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi. |

| | |
|---|---|
| 11. | Text book of Inorganic Chemistry by K. N. Upadhyaya Vikas Publishing House – New Delhi. |
| 12. | Inorganic Chemistry 3rd edn G. L. Miessler and D.A. Tarr, pearson publication |

## E) Suggested methods of Teaching:

| | |
|---|---|
| i) | Class room teaching |
| ii) | Online teaching in various platform like zoom, Google meet, Microsoft team etc |
| iii) | Collaborative teaching with industrial visit to understand instruments. |
| iv) | Interaction with subject experts to improve basic and advance knowledge about subject. |

| **F) Course Outcomes:** | | **Blooms Taxonomy** |
|---|---|---|
| CO1 | Student will understand the mechanism of the reactions involved in inorganic complexes of transition metals. | |
| CO2 | Student will understand generation of nuclear power with the help of nuclear reactions. | |
| CO3 | Knowledge of characteristics, properties and separation of lanthanides and Actinides. | |
| CO4 | Understanding techniques involve in ore dressing and extraction of cast iron from its ore. | |

| **G) Scheme of Course Evaluation** | | |
|---|---|---|
| **1.** | End Semester Examination (ESE) | 40 |
| **2.** | Continuous Internal Evaluation (CIE) | 10 |
| **3.** | **Total Marks** | **50** |

| **H) Suggested techniques for Continuous Internal Evaluation online / offline ( 10 Marks) (Any one as per condition)** | | |
|---|---|---|
| **1.** | MCQ exam | |
| **2.** | Attendance | |
| **3.** | Home Assignments | |
| **4.** | Industrial Visit | |
| **5.** | Oral | |
| **6.** | Surprise test | |
| **7.** | Open book test | |
| **8** | Seminar | |
| **5.** | **Total Marks** | **10** |

| **I) Question Paper Pattern (40 Marks)** | | |
|---|---|---|
| **Q. No.** | **Nature / Type of Question** | **Marks** |
| **1.** | Answer in one sentence. (4 que 1 mark each) | 04 |

| | | |
|---|---|---|
| **2.** | MCQ. | 04 |
| **3.** | Solve any two out of three. (8 mark each) | 16 |
| **4.** | Solve any four out of six. (4 mark each) | 16 |
| **5.** | **Total Marks** | **40** |

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# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

## Affiliated to Shivaji University, Kolhapur

**(New syllabus under Autonomy to be introduced from June, 2021 onwards)**

| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **III** | Semester | **VI** |
| Course | | Course Code | **DSE-E6** |
| Paper No. | | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2023 - 24** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **Organic chemistry** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | To understand the basics Knowledge of reagents used in organic transformations. |

| | |
|---|---|
| ii) | To study various reactions used in organic synthesis. |
| iii) | To Knowing basic terms used in retrosynthetic analysis, |
| iv) | To study concept of terpenoids and alkaloids. |

**C) Course Syllabi:**
(CR = Credits / IH: Instructional Hours)

| Modules | CR | IH |
|---|---|---|
| **Module1. Reagents and Reactions in Organic Synthesis** | **02** | **10** |
| 1.1 **A] Reagents-** Preparation and Applications of following reagents- Lithium aluminium hydride LiAlH4, Raney Nickel, Osmium tetraoxide, Selenium dioxide (SeO2), Dicyclohexyl Carbodiimide (DCC), Diazomethan. | | |
| 1.2 **B] Reactions**<br>Statement, General Reaction, Mechanism and Synthetic applicationsDiels -Alder reaction, Meerwein–Pondorff-Verley reduction, Hofmann rearrangement, Wittig reaction, Wagner- Meerwein rearrangement, Baeyer Villiger oxidation. | | |
| 1.3 Problem based on above reactions. | | |
| **Module 2. Retrosynthesis** | **02** | **06** |
| 2.1 **I**ntroduction. | | |
| 2.2 Recapitulation of basics of reaction mechanism and reagents. | | |
| 2.3 Terms used- Target molecule (TM), Disconnection, Synthons, Synthetic equivalence, Functional group interconversion (FGI), one group disconnection (w. r. t. suitable examples). | | |
| 2.4 Retrosynthetic analysis and synthesis of target molecules: Cinnamaldehyde, Cyclohexene, para methoxy acetophenone, Methyl-3phenyl propionate, α,α-dimethyl benzyl alcohol, Paracetamol. | | |

| | | |
|---|---|---|
| **Module 3. Electrophilic addition to >C=C< and −C≡C− bonds** | **02** | **08** |
| 3.1 A] **Addition to Carbon-Carbon double (>C=C<) bond:** Introduction, Examples of addition reactions. | | |
| 3.2 Mechanism of electrophilic addition to >C=C< bond, orientation & reactivity, i. Hydrohalogenation, ii. Anti-Markovnikoff's addition (peroxide effect). iii. Rearrangements (support for formation of carbocation). Addition of halogens. v. Addition of water. vi. Addition of hypohalous acids (HO-X). vii. Hydroxylation (formation of 1,2-diols). viii. Hydroboration-oxidation (formation of alcohol). ix. | | |
| Hydrogenation (formation of alkane). x. Ozonolysis (formation of aldehydes & ketones). | | |
| 3.3 **B] Addition to Carbon-Carbon triple (−C≡C−) bond:** Introduction, Examples of addition reactions. | | |
| 3.4 **Mechanism of electrophilic addition to−C≡C−bond.** i. Addition of halogens. ii. Addition of halogen acids. iii. Addition of hydrogen. iv. Addition of water. v. Formation of metal acetylides. | | |
| **Module 4. Natural Products** | **02** | **08** |
| 4.1 A] Terpenoids: Introduction, Occurrence, Isolation, General Characteristic and Classification. | | |
| 4.2 General Methods for structure determinations. | | |
| 4.3 Isoprene rule. | | |
| 4.4 Analytical evidences and synthesis of Citral | | |
| 4.5 **B] Alkaloids**: Introduction, Occurrence, Isolation, Classification, Properties. | | |
| 4.6 General Methods for structure determination. | | |
| 4.7 Analytical evidences and synthesis of Nicotine. | | |

| Module 5. Pharmaceuticals | 02 | 06 |
|---|---|---|
| 5.1 Introduction | | |
| 5.2 Classification. | | |
| 5.3 Qualities of ideal drug. | | |
| 5.4 Synthesis and uses of ethambutal, phenobarbitone, isoniazide, benzocaine, Chloramphenicol,paludrine. | | |
| 5.5 Drug action of sulpha drugs. | | |

| **D) Reference Materials** | |
|---|---|
| **D1) Text Books for Reading** | |
| 1. | Phadake |
| 2. | Nirali |
| **D2) Books for Reference** | |
| 1. | Organic Reactions and Their Mechanisms P. S. Kalsi 3rd Revised edition. |
| 2. | Advanced organic Chemistry by B.S. Bahl & Arun Bhal (Reprint in 1997 |
| 3. | Mechanism and Structure in Organic Chemistry. April,1963 By Edwin S.Gould. |
| 4. | A guidebook to mechanism in Organic Chemistry sixth Edition by Peter Syke. |
| 5. | Organic Synthesis: The Disconnection Approach by Stuart Warren |
| 6. | Organic Synthesis Through Disconnection Approach by P. S. Kalsi |
| 7. | Fundamentals of Organic Synthesis the Retrosynthetic Analysis by Ratan Kumar Kar |
| 8. | Advanced organic Chemistry by B.S. Bahl & Arun Bhal (Reprint in 1997) |
| 9. | Organic Chemistry Natural Products Vol I, by O. P.Agrawal. |
| 10. | Industrial Chemistry-B.K. Sharma, Goyal publishing house,Mirut |

| | |
|---|---|
| 11. | Shreeves chemical process industries 5th Edition, G.T. Oustin, McGrawHill |
| 12. | Synthetic drugs by M.S.Yadav,Campus book international. |

## E) Suggested methods of Teaching:

| | |
|---|---|
| i) | Class room teaching |
| ii) | Online teaching in various platform like zoom, Google meet, Microsoft team etc |
| iii) | Collaborative teaching with industrial visit to understand instruments. |
| iv) | Interaction with subject experts to improve basic and advance knowledge about subject. |

| **F) Course Outcomes:** | | **Blooms Taxonomy** |
|---|---|---|
| CO1 | Student will learn addition reaction across >C=C< bond w.r.t. hydrohalogenation, hydration hydroxylation, ozonolysis and addition of halogen, halogen acid, hydrogen, water etc. across −C≡C−bond. | |
| CO2 | Student will understand retrosynthesis of organic compounds. | |
| CO3 | Knowledge of analytical and synthetic evidences of Citral and Nicotine | |
| CO4 | Understanding classification of drugs, Qualities of ideal drug. | |

| **G) Scheme of Course Evaluation** | | |
|---|---|---|
| **1.** | End Semester Examination (ESE) | 40 |
| **2.** | Continuous Internal Evaluation (CIE) | 10 |
| **3.** | **Total Marks** | **50** |

| **H) Suggested techniques for Continuous Internal Evaluation online / offline ( 10 Marks) (Any one as per condition)** | | |
|---|---|---|
| **1.** | MCQ exam | |
| **2.** | Attendance | |
| **3.** | Home Assignments | |
| **4.** | Industrial Visit | |
| **5.** | Oral | |
| **6.** | Surprise test | |
| **7.** | Open book test | |
| **8** | Seminar | |
| **5.** | **Total Marks** | **10** |

**I) Question Paper Pattern (40 Marks)**

| Q. No. | Nature / Type of Question | Marks |
|---|---|---|
| **1.** | Answer in one sentence. (4 que 1 mark each) | 04 |
| **2.** | MCQ. | 04 |
| **3.** | Solve any two out of three. (8 mark each) | 16 |
| **4.** | Solve any four out of six. (4 mark each) | 16 |
| **5.** | **Total Marks** | **40** |

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# Mahavir Mahavidyalaya, Kolhapur (Autonomous)

## Affiliated to Shivaji University, Kolhapur

**(New syllabus under Autonomy to be introduced from June, 2021 onwards)**

| **A) Primary Information:** | | | |
|---|---|---|---|
| Programme | **Bachelor of Science (B. Sc.) CBCS** | | |
| Part | **III** | Semester | **V** |
| Course | | Course Code | **DSE-E7** |
| Paper No. | **XI** | Course Type | **Semester** |
| Total Marks | **50 Marks** | Implementation | **2023 - 24** |
| Total Credits | **02** | Contact Hours | **04 / Week** |
| Course Title | **Physical chemistry** | | |

| **B) Course Objectives:** | |
|---|---|
| i) | Learning and understanding of phase rule, learning of One component, Two component and Three component systems phase diagrams with suitable examples. |
| ii) | Knowledge about basic concept of Thermodyanamics, free energy, Gibbs-Helmholtz equation and its applications, problem related with it. |
| iii) | Learning and understanding Space lattice, lattice sites, Lattice planes, Unit cell. Laws of crystallography, Weiss indices and Miller indices, Cubic lattices and types of cubic lattice, planes or faces of a simple cubic system, Diffraction of Xrays, Derivation of Bragg's equation. Determination of crystal structure by Bragg's method. crystal structure of NaCl and KCl on the basis of Bragg's equation. |
| iv) | Learning of kinetics, Simultaneous reactions such as i)opposing reaction ii)side reaction iii)consecutive reactions: iv) chain reaction v) explosive reaction |
| v) | Learning and understanding the knowledge of distribution law, its modifications, applications of distribution laws, process of extraction, determination of solubility, distribution indicators, molecular weights. |

## C) Course Syllabi:

(CR = Credits / IH: Instructional Hours)

| Modules | CR | IH |
|---|---|---|
| **Module1. Phase Equilibria** | 02 | **07** |
| 1.1 Introduction.<br>1.2 Gibbs phase rule : Phase rule equation and explanation of terms involved in the equation.<br>1.3 Phase diagram, true and metastable equilibria.<br>1.4 One component systems: i. Water system. ii. Sulphur system with explanation for polymorphism.<br>1.5 Two component systems: i. Eutectic system: (Ag – Pb system); | | |
| Desilverisation of lead. ii. Freezing mixture: (KI –H2O system). iii. Formation of compound with congruent melting point (FeCl3 – H2O).<br>1.6 Three component solid-liquid system: i. Development of triangular phase diagram: (Acetic acid – Chloroform –water system). | | |
| **Module 2. Thermodynamics** | 02 | 09 |
| 2.1 Introduction.<br>2.2 Free energy: Gibbs function (G) and Helmholtz function (A), Criteria for thermodynamic equilibrium and spontaneity.<br>2.3 Relation between $\Delta G$ and $\Delta H$ : Gibbs-Helmholtz equation.<br>2.4 Phase equilibria : Clapeyron – Clausius equation and its applications.<br>2.5 Thermodynamic derivation of law of mass action, Van't – Hoff isotherm and isochore.<br>2.6 Fugacity and activity concepts.<br>2.7 Partial molar quantities, Partial molar volume, Concept of chemical potential, GibbsDuhem equation.<br>2.8 Numerical problems. | | |
| **Module 3. The Solid State** | 02 | 09 |
| 3.1 Introduction: Space lattice, lattice sites, lattice planes, unit cell.<br>3.2 Laws of crystallography: i. Law of constancy of interfacial angles ii. Law of rational indices iii. Law of crystal symmetry.<br>3.3 Weiss indices and Miller indices.<br>3.4 Cubic lattice and types of cubic lattice, planes or faces of a simple cubic system, spacing of lattice planes.<br>3.5 Diffraction of X-rays, Derivation of Bragg's equation.<br>3.6 Determination of crystal structure by Bragg's method.<br>3.7 Determination of crystal structure of NaCl and KCl on the basis of Bragg's equation.<br>3.8 Numerical problems. | | |
| **Module 4. Chemical Kinetics** | 02 | 06 |

| | | |
|---|---|---|
| 4.1 Introduction.<br>4.2 Simultaneous reactions such as i. Opposing reaction: (Derivation of rate equation for first order opposed by first order expected). ii. Side reaction. iii. Consecutive reactions. iv. Chain reaction. v. Explosive reaction (Derivation of rate equation and Numerical problems are not expected). | | |
| **Module 5. Distribution law** | 02 | 06 |
| 5.1 Introduction, solute, solvent and solution, miscible and immiscible liquids.<br>5.2 Nernst distribution law and its limitations.<br>5.3 Modification of distribution law with respect to change in molecular state of solute (association and dissociation of solute in one of the solvent).<br>5.4 Applications of the distribution law i. Process of extraction (derivation expected). ii. Determination of solubility of solute in particular solvent. iii. distribution indicators. iv. determination of | | |
| molecular weight of solute in different solvents.<br>5.5 Numerical problems. | | |

## D) Reference Materials

### D1) Text Books for Reading

| | |
|---|---|
| 1. | Phadake |
| 2. | Nirali |

### D2) Books for Reference


1. Physical Chemistry by G. M. Barrow, International student Edition,Mc Graw Hill.

2. University General Chemistry by C.N.R. Rao, Macmillan.

3. Physical Chemistry by, R. A. Alberty, Wiley Eastern Ltd.

4. The Elements of Physical Chemistry by P. W. Atkins, Oxford.

5. Principles of Physical Chemistry by S. H. Maron, C. H. Prutton, 4thE dition.

6. Nuclear and Radiochemistry by Friedlander, Kennedy and Miller, John Wiley and Sons. Wiley International edition.

7. Essentials of Nuclear Chemistry by H. J. Arnikar, 4th edition. Wiley Eastern.

8. Principles of Physical Chemistry by Puri, Sharma, Pathania,Shobhanlal Naginchand and Company, Jalandar.

9. Instrumental methods of chemical analysis by Chatwal and Anand,5th Edition, Himalaya Publication.

10. Fundamentals of molecular spectroscopy by C. N. Banwell – Tata Mc Graw-Hill.

11. Quantum Chemistry including molecular spectroscopy by B. K. Sen,Tata Mc Graw -Hill. 12. Text Book of Physical Chemistry by S. Glasstone, Macmillan India Ltd.

12. Elements of Physical Chemistry by D. Lewis and S. Glasstone (Macmillan).

13. Principles of Physical Chemistry by Maron and Lando (Amerind).

| |
|---|
| 14. Electrochemistry by S. Glasstone. |
| 15. Physical Chemistry by W. J. Moore. |
| 16. Basic Chemical Thermodynamics by V. V. Rao (Macmillan). |
| 17. Essential of Physical Chemistry, Bahl and Tuli (S. Chand). |
| 18. Text Book of Physical Chemistry, Soni and Dharmarha. |
| 19. Advanced Physical Chemistry Gurdeep Raj GOEL Publishing House, 36th Edition |

## E) Suggested methods of Teaching:

| | |
|---|---|
| i) | Class room teaching |
| ii) | Online teaching in various platform like zoom, Google meet, Microsoft team etc |
| iii) | Collaborative teaching with industrial visit to understand instruments. |
| iv) | Interaction with subject experts to improve basic and advance knowledge about subject. |

| **F) Course Outcomes:** | | **Blooms Taxonomy** |
|---|---|---|
| CO1 | Students learned One component, Two component and Three component systems phase diagrams . | |
| CO2 | Students know Thermodynamics, free energy, GibbsHelmholtz equation and its applications. | |
| CO3 | Students able to understand laws of crystallography, Bragg's equation. | |
| CO4 | Student learn kinetics, Simultaneous reactions. | |

| **G) Scheme of Course Evaluation** | | |
|---|---|---|
| **1.** | End Semester Examination (ESE) | 40 |
| **2.** | Continuous Internal Evaluation (CIE) | 10 |
| **3.** | **Total Marks** | **50** |

| **H) Suggested techniques for Continuous Internal Evaluation online / offline ( 10 Marks) (Any one as per condition)** | | |
|---|---|---|
| **1.** | MCQ exam | |
| **2.** | Attendance | |
| **3.** | Home Assignments | |
| **4.** | Industrial Visit | |
| **5.** | Oral | |
| **6.** | Surprise test | |
| **7.** | Open book test | |

| | | |
|---|---|---|
| **8** | Seminar | |
| **5.** | **Total Marks** | **10** |

| **I) Question Paper Pattern (40 Marks)** | | |
|---|---|---|
| **Q. No.** | **Nature / Type of Question** | **Marks** |
| **1.** | Answer in one sentence. (4 que 1 mark each) | 04 |
| **2.** | MCQ. | 04 |
| **3.** | Solve any two out of three. (8 mark each) | 16 |
| **4.** | Solve any four out of six. (4 mark each) | 16 |
| **5.** | **Total Marks** | **40** |

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