AC 25.04.24 ITEM NO: 22.2

Deccan Education Society's

Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for
Program: Bachelor of Science
Course: S.Y.B.Sc (NEP 2020)
Subject: Chemistry

Choice Based Credit System (CBCS)
with effect from
Academic Year 2024-2025

Deccan Education Society's

Kirti M. Doongursee College (Autonomous) Proposed Curriculum as per NEP 2020

Year of implementation- 2024-25

Name of the Department: Chemistry

Semester	Course Code	Course Title	Vertical	Credit
III	24 CHE MJ 311	Chemistry-I	Major	2
	24 CHE MJ 312	Chemistry-II	Major	2
	24 CHE MJ P 3 1	Chemistry Practical-I	Major	4
	24 CHE OE 331	Energy Resources	Open Elective	2
	24 CHE VC 341	Basic Skills in Analytical Chemistry	Vocational Skill Course	2
	24 CHE MR 321	Basics of Chemistry-I	Minor	2
	24 CHE MR P 31	Basic Chemistry Practical-I	Minor	2
IV	24 CHE MJ 411	Chemistry-III	Major	2
	24 CHE MJ 412	Chemistry-IV	Major	2
	24 CHE MJ P 41	Chemistry Practical-II	Major	4
	24CHE MR 421	Basics in Chemistry-II	Minor	2
	24 CHE MR P 41	Basic Chemistry Practical-II	Minor	2
	24 CHE SE 451	Cosmetics Analysis and Preparations.	Skill Enhancement Course	2
	24 CHE OE 431	Chemistry of Commercial Product used in daily life	Open Elective	2

PROGRAM OUTCOMES

PO	Description
A student completing Bachelor's Degree in **Science** Program will be able to	
PO1	Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate Programme. Execute strong theoretical and practical understanding generated from the specific graduate Programme in the area of work.
PO2	Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions
PO3	Social competence: Display the understanding, behavioral skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research
PO5	Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	Personal and professional competence: Performing dependently and collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centered national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

SEM – III

Course Code	MAJOR Course	Credits	Lectures/ Week
24 CHE MJ 311	**Paper I CHEMISTRY-I**	**2**	**2**

Course Outcomes: Unit-I

After successful completion of this course, students would be able to:

CO1: Recall the different terms related to conductance, Free Energy Functions etc.

CO2: Understand the dependence of conductance of strong and weak electrolytes on concentration,the concept of transport (transference) number, partial molal properties, fugacity and activity

CO3: Application of Kohlrausch's law of independent migration of ions in conductance measurements , application of thermodynamics by deriving equations)

CO4: Analyze and evaluate transport number experimentally.

Unit	Topics	No of Lectures
I	**Electrolytic Conductance** 1.1 Recapitulation: Difference between -Electrolyte and non-electrolyte, strong and weak Electrolytes, Metallic (Electronic) conductance and Electrolytic conductance 1.2 Conductivity (Specific Conductance), equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Concept of limiting molar conductivity. 1.3 Kohlrausch's law of independent migration of ions. 1.4 Applications of conductance measurement: determination of limiting molar conductance of weak electrolytes, determination of degree of ionization and ionization constant of weak electrolyte, solubility and solubility product of sparingly soluble salts, (Numerical expected). 1.5 Migration of ions, ionic mobility, Transference number, dependence of transport number on velocity of ions.	**10**

	1.6 Experimental determination of transport number using Moving boundary method. (Numerical expected). Factors affecting transference number.	
II	**Chemical Thermodynamics-II** 1.1Free Energy Functions: Helmholtz Free Energy, Gibb's Free Energy, Variation of Gibb's free energy with Pressure and Temperature. 1.2 Gibbs-Helmholtz equation, van't Hoff reaction isotherm and van't Hoff reaction isochore. (Numerical expected). 1.3 Thermodynamics of Open System: Partial Molal Properties, Chemical Potential and its variation with Pressure and Temperature, Gibb's Duhem equation. 1.4 Concept of fugacity and Activity.	**10**
III	**Selected topics on p-block elements** Chemistry of Boron Compounds (04L) Electron deficient compounds–BH_3, BF_3, BCl_3 with respect to Lewis acidity and applications. Preparation of simple boranes like diborane and tetraborane. Structure and bonding in diborane and tetraborane(2e-3C bonds) Chemistry of Silicon Silicon compounds: Occurrence, Structure and Inertness of SiO_2,Preparation and structure of $SiCl_4$ Chemistry of Nitrogen family Trends in chemical reactivity - Formation of hydrides, halides, oxides with special reference to oxides of nitrogen. Oxides of nitrogen with respect to preparation and structure of NO, NO_2, N_2O and N_2O_4.	**10**

References:

<u>Unit I</u>

1. Electrolyte Solution, R. A. Robinson and R.H. Stokes, Second Revised Edition, Butterworth & Co (Publishers) Ltd.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 41st Millennium Edition, Vishal Publishers
3. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
4. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
5. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry CengageLearning India Pvt.Ltd., New Delhi (2009).

6. 6.Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
7. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co., NewYork (1985).
8. K.L.Kapoor A textbook of Physical Chemistry 3rd Ed. vol.1,2 Macmillan Publishing Co., NewDelhi(2001)

Unit II & III

9. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
10. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
11. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
12. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
13. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning
14. India Edition, 2002.

Course Code	MAJOR SEM -III	Credits	Lectures /Week
24 CHE MJ 311	PAPER II CHEMISTRY - II	2	2

Course Outcomes:

After successful completion of this course, students would be able to:

CO1: To define Aromaticity, ortho/para directors, Alcohols, Phenols and Epoxides, and the criteria for an aromatic compound. To remember the basics of Valence Bond Theory and it's limitations.

CO2: To understand the Huckel rule and its application in determining the aromaticity of compounds & the mechanism of electrophilic aromatic substitution reactions. To understand LCAO principle and to explain the concept of molecular orbitals and their energy level.

CO3: To apply the knowledge to identify organic compounds are aromatic, anti- aromatic or nonaromatic.

CO4: To differentiate aromatic, anti-aromatic and nonaromatic compounds. To analyze and predict the bonding characteristics of molecules using VBT, MOT. To analyze the compounds for hybridization and LCAO principle to explain the formation of homonuclear diatomic molecules.

Unit	Topics	No of Lectures
I	**Chemical Bonding** **Directional Bonding: Orbital Approach.** Covalent Bonding, Review of Valence Bond Theory **Concept of Hybridization :** Definition, Steps involved in hybridization, types of hybridization, Structure and bonding of molecules having sp, sp^2, sp^3, sp^3d, sp^3d^2 hybridization with bond angles and molecular geometry. **Molecular Orbital Theory** Comparing Atomic Orbitals and Molecular Orbitals. Linear combination of atomic orbitals to give molecular orbitals LCAO-	10

	MO approach for diatomic homonuclear molecules). Molecular orbital Theory and Bond Order and magnetic property: with reference to H_2, Be_2, N_2,O_2, O_2 ,+O^{2-} ,O_2^{2-} , CO, NO w.r.t. bond order, stability and magnetic character.	
II	**Aromatic Hydrocarbons and Aromaticity:** Aromaticity: Hückel's rule, non-aromatic, anti-aromaticity, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft alkylation/acylation with their mechanism. Directing effects of the groups (-NO_2, -NH_2, -OH).	**10L**
III	**Alcohols Phenols and Epoxides:** **Alcohols:** Nomenclature, Preparation: Hydration of alkenes, hydrolysis of alkyl halides, reduction of aldehydes and ketones, using Grignard reagent. Properties: Hydrogen bonding, types and effect of hydrogen bonding on different properties. Acidity of alcohols, Reactions of alcohols **Phenols:** Preparation, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols. **Epoxides:** Nomenclature, methods of preparation and reactions of epoxides: reactivity, ring opening reactions by nucleophiles (a) In acidic conditions: hydrolysis, reaction with halogen halide, alcohol, hydrogen cyanide. (b) In neutral or basic conditions: ammonia, amines, Grignard reagents, alkoxides.	**10L**

References:

Unit I & II

1. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
4. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage

Learning India Edition, 2013
5. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley:
6. London, 1994.
7. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.

Unit II

8. Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch
9. Instrumental methods of analysis by Willard, H.H.; Merritt, L.L. Jr.; Dean, J.A.; Settle,7th Edition
10. Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Holler, S. R. Crouch
11. Modern Analytical Chemistry by David Harvey, McGraw-Hill Higher Education
12. Skoog et al. “Fundamentals of Analytical chemistry" Cengage Learning, Eight Edition, chapter 13, 14 and 15
13. Day and Underwood, “Quantitative analysis" prentice hall 1991, chapter3
14. S.M. Khopkar, “ Basic Concepts of Analytical Chemistry”, IInd Edition NewAge International Publisher
15. Gary D. Christan,” Analytical Chemistry”, VIth Edition, Wiley Students Edition, Chapter No 8,9,10 5) Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Holler, S. R. Crouch

Course Code	MINOR SEM – III	credits	lectures /week
24 CHE MR 321	BASICS OF CHEMISTRY I	**2**	**2**

CO1: Define electrolyte, non-electrolyte, and conductance. Recall compounds of Boron and silicon. Define aromaticity and aromatic compounds.
CO2: Understand concept of transference number, Lewis acidity structures SiO_2. To understand the Huckel's rule and aromaticity in different compounds.
CO3: Equivalent and molar conductivity, Apply the knowledge of aromaticity in classifying compounds as aromatic, non-aromatic and anti-aromatic.
CO4: Solubility and solubility product, to analyze the mechanisms of aromatic electrophilic substitution reactions.

UNIT	TOPICS	No of Lectures
I	**ELECTROLYTIC CONDUCTANCE (10L)** 1.1 Recapitulation: Difference between -Electrolyte and non-electrolyte, strong and weak Electrolytes, Metallic (Electronic) conductance and Electrolytic conductance 1.2 Conductivity (Specific Conductance), equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Concept of limiting molar conductivity. 1.3 Kohlrausch's law of independent migration of ions. 1.4 Applications of conductance measurement: determination of limiting molar conductance of weak electrolytes, determination of degree of ionization and ionization constant of weak electrolyte, solubility and solubility product of sparingly soluble salts, (Numerical expected). 1.5 Migration of ions, ionic mobility, Transference number, dependence of transport number on velocity of ions. 1.6 Experimental determination of transport number using Moving boundary method. (Numerical expected). Factors affecting transference number.	10

II	**Selected topics on p-block elements (10L)** Chemistry of Boron Compounds (04L) Electron deficient compounds–BH3,BF3,BCl3with respect to Lewis acidity and applications. Preparation of simple boranes like diborane and tetraborane. Structure and bonding in diborane and tetraborane(2e-3cbonds) Chemistry of Silicon (02L) Silicon compounds: Occurrence, Structure and Inertness of SiO2 Preparation and structure of SiCl4	10
III	**Aromatic Hydrocarbons and Aromaticity:** Aromaticity: Hückel's rule, non-aromatic, anti-aromaticity, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft alkylation/acylation with their mechanism. Directing effects of the groups (-NO_2, -NH_2, -OH).	10

REFERENCE:

Unit I

1. Electrolyte Solution, R. A. Robinson and R.H. Stokes, Second Revised Edition, Butterworth & Co (Publishers) Ltd.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 41st Millennium Edition, Vishal Publishers
3. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
4. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
5. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry CengageLearning India Pvt.Ltd., New Delhi (2009).
6. 6.Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
7. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co., NewYork (1985).
8. K.L.Kapoor A textbook of Physical Chemistry 3rd Ed. vol.1,2 Macmillan Publishing Co., NewDelhi(2001)

Unit II

9. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
10. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
11. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
12. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
13. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Unit III

14. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
15. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
16. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
17. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013
18. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
19. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.

Course Code	**OPEN ELECTIVE SEM- III**	**Credits**	**Lectures/ Week**
24CHE OE 331	**Paper-I Energy Sources**	**2**	**2**

Course Outcomes:

After completion of course, the student will be able to:

CO1: Remember various sources of energies.

CO2: Achieve a clear conceptual understanding of technical and commercial aspects of sources of Energy.

CO3: Describe sources and uses of energy and apply the knowledge to differentiate renewable and non-renewable sources of energy conventional and non-conventional sources of energy.

CO4: Analyze the use and effectiveness of renewable sources of energy. Provide examples of common types of renewable and non-renewable resources.

Unit	**Topics**	**No of Lectures**
I	**Renewable Energy Sources** 1. Introduction to Renewable Energy Sources, 2. Energy Concept-Sources in General, its Significance & necessity, 3. Classification of Energy Sources: Primary and Secondary Energy, Commercial and Non-Commercial Energy, Renewable and Non-renewable Energy, Conventional and Non-Conventional Energy. 4. Importance of Non-Commercial Energy Resources.	15

	5. Renewable Energy Sources: Need of Renewable Energy, Non-Conventional Energy Sources, an Overview of Developments in Offshore Wind Energy, 6. Tidal Energy, Wave Energy Systems, Ocean Thermal Energy Conversion, 7. Solar Energy, Biomass, Biochemical Conversion, Biogas Generation, Geothermal Energy Tidal Energy, Hydroelectricity.	
II	**Solar Energy** 1. Solar Energy: Solar Energy-Key Features, Its importance, 2. Merits & Demerits of Solar Energy, Applications of Solar Energy, Solar Water Heater, Flat Plate Collector, Solar Distillation, Solar Cooker, Solar Green Houses, Solar Cell -Brief discussion of each **Wind Energy** 1. Fundamentals of Wind Energy, 2. Wind Turbines and Different Electrical Machines in Wind Turbines, 3. Power Electronic Interfaces, and Grid Interconnection topologies, 4. Ocean Energy Potential against Wind and Solar, 5. Wave Characteristics and Statistics, Wave Energy devices, 6. Tide Characteristics and Statistics, Tide Energy technologies 7. Ocean Thermal Energy	09 06

References:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Renewable Energy, Power for a sustainable future, Godfrey Boyle, 2004, Oxford University Press, in association with The Open University.
5. Solar Energy: Resource Assessment, Dr. P Jayakumar, Handbook, 2009
6. Photovoltaics, J. Balfour, M. Shaw and S. Jarosek, Lawrence J Goodrich (USA).
7. Biomass Regenerable Energy, D D Hall and R P Grover Wiley; 1st edition (May 18, 1987).
8. Introduction to Renewable Energy Technology: A Year Long Science and Technology Course, United States Department of Energy
9. Introduction to Renewable Energy (Energy and the Environment), Vaughn Nelson, Create Space Independent Publishing Platform (February 3, 2015).
10. Renewable Energy Integration (Green Energy and Technology), Jahangir Hossain and Apel Mahmud, Springer; 2014th edition (February 14, 2014)

Course Code	VOCATIONAL SKILL COURSE SEM – III	Credits	Lectures/ Week
24 CHE VC 341	Paper I BASIC SKILLS IN ANALYTICAL CHEMISTRY	2	4

Course Outcomes:

CO1: Define and recall tools of analytical chemistry.

CO2: To understand instrumentation of analytical instruments.

CO3: Apply to determine quantity of samples colorimetrically, gravimetrically and with instruments

CO4: Analyze the constituents of organic mixtures by chromatography.

1,2,3	Tools of Analytical Chemistry-I (2 Practicals) a. Analytical glasswares like burettes, pipettes, standard flasks, separating funnels. b. Weighing tools such as digital balances. c. Incineration devices: Burners, electrical incinerators, muffle furnace d. drying devices: hot air oven, microwave oven, desiccator, vacuum desiccator e. Monochromators, filters, sample holder, prisms, diffraction gratings, photoemissive cells, photomultiplier tubes, (The learner should draw diagrams and write-ups providing uses, care and maintenance of the items mentioned in (a) and principle, construction and uses of items (b) to (e) in his journals.)
4	Gravimetric estimation of nickel (II) as nickel-dmg complex.
5	Gravimetric estimation of barium as barium chromate.
6	Determination of copper ions in the given solution by using calibration curve colorimetrically.
7	Determination of buffer capacity of acid buffer and basic buffer using pH-meter.
8	Estimation of aspirin.
9,10,11	Tools of analytical chemistry-II (a) Filtration flasks, funnels, separating funnels, distillation apparatus, vacuum distillation assembly, centrifugation machine, electrophoresis apparatus. (b) Development chamber for chromatography. (c) Electrodes like reference electrodes and indicator electrodes (with

	respect to care and maintenance). (d) Conductometry cells (with respect to care and maintenance). (e) Combined glass electrode (with respect to care and maintenance). (f) Types of salt bridges and preparation of any one or use of salt bridge, its effect on the potential of a given electrode/cell. ((The learner should draw diagrams and write-ups providing uses in (a) and (b) and principle, construction and uses of items (c) to (f) in his journal).
12	Separation of solute between two immiscible solvents to determine the distribution ratio and/or extraction efficiency.
13	Estimation of Fe(II) in the given solution by titrating against K2Cr2O7 potentiometrically.
14	Estimation of sulphate as BaSO4.
15	Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Reference Books:

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
3. Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry 6th Ed.*, Saunders College Publishing, Fort Worth (1992).
4. Harris, D. C. *Quantitative Chemical Analysis*.
5. W. H. Freeman, Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill.
6. Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.
7. Freifelder, D. *Physical Biochemistry 2nd Ed.*, W.H. Freeman and Co., N.Y. USA (1982).
8. Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16 (1977).
9. Vogel, A. I. *Vogel's Qualitative Inorganic Analysis 7th Ed.,* Prentice Hall.
10. Vogel, A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.*, Prentice Hall.
11. Robinson, J.W. *Undergraduate Instrumental Analysis 5th Ed.*, Marcel Dekker, Inc., New York (1995).

Course Code	MAJOR SEM-IV	Credits	Lectures/ Week
24 CHE MJ 411	**Paper I CHEMISTRY-III**	**2**	**2**

Course Outcomes:

After successful completion of this course, students would be able to:

CO1: Remember the effect of temperature on reaction rates, types of electrochemical cells

CO2: Understand the concept of reaction mechanism, reversible and irreversible cells

CO3: Apply the Arrhenius equation to find energy of activation of Chemical reactions, application of cell e.m.f. in the determination of thermodynamic parameters, pH, equilibrium constant

CO4: Explore theories to explain the effect of temperature on reaction rates, types of galvanic cells.

Unit	Topics	No of Lectures
I	**1. CHEMICAL KINETICS (10L)** 1.1 Effect of temperature on the rate of reaction, Arrhenius equation, Concept of energy of activation (Ea). (Numerical expected). 1.2 Theories of reaction rates: Collision theory and activated complex theory of bimolecular reactions. Comparison between the two theories (Qualitative treatment only) 1.3 Introduction to reaction mechanism (concept of elementary steps, intermediates, and the overall reaction mechanism with an example of Thermal chain reactions: H2. and Br2. reaction. 1.4 Types of Complex Chemical reactions: Reversible or opposing, consecutive and parallel reactions (No derivations, only examples expected)	**10**

II	**2.ELECTROCHEMISTRY** 1.1 Electrochemical cells- Electrolytic and Galvanic cells. 1.2 Electrochemical conventions to represent Galvanic cells 1.3 Reversible and irreversible cells 1.4 Nernst equation and its importance (Numerical expected) 1.5 Types of electrodes, Standard electrode potential, electrochemical series (Numerical expected). 1.6 Thermodynamics of a reversible cell - calculation of thermodynamic properties such as ΔG, ΔH and ΔS from EMF data. (Numerical expected) 1.7 Calculation of equilibrium constant from EMF data. (Numerical expected) 1.8 pH determination using hydrogen electrode and quinhydrone electrode.(Numerical expected) 1.9 Types of Galvanic cells- Chemical cells and Concentration Cells	**10**
III	**OXIDATION REDUCTION** **Introduction to oxidation and reduction:** Oxidation, Reductions, Oxidizing and Reducing agents, Oxidation number, Rules to assign Oxidation numbers with examples ions like oxalate, permanganate and dichromate. **Reduction Oxidation reactions (Redox Reactions):** Half reactions, Balancing redox reactions Electrode potential, Standard electrode potential, E.M.F. of a cell, Electrochemical series. Application of redox chemistry .Extraction of elements(Example-isolation of copper by auto reduction) .Redox reagent in volumetric analysis: a) I2 b) KMnO4 .Titration curves- Single electron system (Ex. Ce(IV) against Fe(II) Multi electron systems as in $KMnO_4$ agaist Fe(II)	**10**
References: **<u>Unit I & Unit-II</u>**		

1. Principles of Physical Chemistry, Puri, Sharma, Pathania, 41st Millennium Edition, Vishal Publishers
2. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
3. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
4. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
5. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
6. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co., NewYork (1985).
7. K.L.Kapoor A textbook of Physical Chemistry 3rd Ed. vol.1,2 Macmillan Publishing Co., NewDelhi(2001)

Unit III

8. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
9. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
10. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
11. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
12. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Course Code	MAJOR SEM – IV	Credits	Lectures/Week
24 CHE MJ 412	Paper II CHEMISTRY-IV	2	2

Course Outcomes:

After successful completion of this course, students would be able to

CO1: Recollect the separation techniques, Projection formulae of organic compounds

CO2: Understand separation methods based on Solubilities, Gravity and Volatility**.** To understand Geometrical isomerism, Optical Isomerism of organic compounds.

CO3: Apply it for separation based on Chromatography.

CO4: Analyze organic and inorganic compounds with Chromatography. Conformational analysis of organic compounds.

Unit	Topics	No. of Lectures
I	**Introduction to Coordination Chemistry:** Introduction to Chemistry of Coordination Compounds i. Historical perspectives: Early ideas on coordination compounds ii. Basic terms and nomenclature. iii. Types of ligands iv. Isomerism: General Types with special reference to stereo isomerism of coordination compounds (C.N=6) v. Evidence for the formation of coordination compounds. Theories of coordination compounds i. Werner's Theory of coordination compounds, ii. Effective atomic number rule. iii. Eighteen electron Rule Nature of the Metal-Ligand Bond: i. Valence Bond Theory; Hybridisation of the central metal orbitals-sp3 d 2 /d2 sp3 ii. Inner and outer orbital complexes of .(suitable examples of Mn(II)Fe(II), Fe(III), Co(II)/Co(III), Ni(II), Cu(II) Zn(II) complexes with ligands like aqua, ammonia CNand halides may be used) iii.Limitations of V.B.T. Application of coordination compounds.	10
	Carbonyl Compounds: Nomenclature of aliphatic, alicyclic and aromatic carbonyl compounds. Structure, reactivity of aldehydes and ketones and methods of preparation; Oxidation of primary and	

II	secondary alcohols using PCC, hydration of alkynes, action of Grignard reagent on esters, Rosenmund reduction, Gattermann – Koch formylation and Friedel Craft acylation of arenes Reactions of aldehydes and ketones with $NaHSO_3$, HCN, RMgX, amine, 2,4-Dinitrophenyl hydrazine, $LiAlH_4$ and $NaBH_4$. Mechanisms of following reactions: Aldol Condensation, Benzoin condensation, and Cannizzaro's reaction.	**10L**
III	**Carboxylic acid and their derivatives:** Nomenclature, structure and physical properties, acidity of carboxylic acids, effects of substituents on acid strength of aliphatic and aromatic carboxylic acids. Preparation of carboxylic acids: oxidation of alcohols and alkyl benzene, carbonation of Grignard and hydrolysis of nitriles. Reactions: Acidity, salt formation, decarboxylation, Reduction of carboxylic acids with $LiAlH_4$, diborane, Hell-Volhard-Zelinsky reaction, Conversion of carboxylic acid to acid chlorides, esters, amides and acid anhydrides. Mechanism of Claisen condensation and Dieckmann condensation.	**10L**

References:

Unit-I

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
3. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
5. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Unit-II & III

6. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
7. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
8. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).

9. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
10. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.

Course Code	MINOR SEM –IV	Credits	Lectures/ Week
24 CHE MR 421	**Paper-II BASICS OF CHEMISTRY-II**	**2**	**2**

CO1: Remember the definitions of terms such as Normality, molarity, molality etc.. Atomic Model, Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Structure of hydrogen atom. Recall Nomenclature, structure and properties of carboxylic acids.

CO2: To understand the procedures of preparation of solutions in ppm, ppb, N, M etc. and Rutherford's Atomic Model, Bohr's theory, its limitations and atomic spectrum of hydrogen atom. To understand the reactivity of carboxylic acids.

CO3: To apply the knowledge in writing reactions of carboxylic acids and name reactions and preparation of solution of required concentration.

CO4: Analyze and determine the concentration of solutions. Analyze the mechanisms of Claisen and Dieckmann condensation.

Unit	Topics	No of Lectures
I	**ELECTROCHEMISTRY** 1.1 Electrochemical cells- Electrolytic and Galvanic cells. 1.2 Electrochemical conventions to represent Galvanic cells 1.3 Reversible and irreversible cells 1.4 Nernst equation and its importance (Numerical expected) 1.5 Types of electrodes, Standard electrode potential, electrochemical series (Numerical expected). 1.6 Thermodynamics of a reversible cell - calculation of thermodynamic properties such as ΔG, ΔH and ΔS from EMF data. (Numerical expected) 1.7 Calculation of equilibrium constant from EMF data. (Numerical expected) 1.8 pH determination using hydrogen electrode and quinhydrone electrode.(Numerical expected) 1.9 Types of Galvanic cells- Chemical cells and Concentration Cells	**10L**
	Introduction to Coordination Chemistry: Introduction to Chemistry of Coordination Compounds i. Historical perspectives: Early ideas on coordination compounds	

II	ii. Basic terms and nomenclature. iii. Types of ligands iv. Isomerism: General Types with special reference to stereo isomerism of coordination compounds (C.N=6) v. Evidence for the formation of coordination compounds. **Theories of coordination compounds** i. Werner's Theory of coordination compounds, ii. Effective atomic number rule. iii. Eighteen electron Rule Nature of the Metal-Ligand Bond: iv. Valence Bond Theory; Hybridisation of the central metal orbitals-sp3 d 2 /d2 sp3 v. Inner and outer orbital complexes of .(suitable examples of Mn(II)Fe(II), Fe(III), Co(II)/Co(III), Ni(II), Cu(II) Zn(II) complexes with ligands like aqua, ammonia CNand halides may be used) iii. Limitations of V.B.T Application of coordination compoundss.	**10L**
III	**Carboxylic acid and their derivatives:** Nomenclature, structure and physical properties, acidity of carboxylic acids, effects of substituents on acid strength of aliphatic and aromatic carboxylic acids. Preparation of carboxylic acids: oxidation of alcohols and alkyl benzene, carbonation of Grignard and hydrolysis of nitriles. Reactions: Acidity, salt formation, decarboxylation, Reduction of carboxylic acids with LiAlH4, diborane, Hell-Volhard-Zelinsky reaction,Conversion of carboxylic acid to acid chlorides, esters, amides and acid anhydrides. Mechanism of Claisen condensation and Dieckmann condensation.	**10L**

References:

Unit I:

1. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).
2. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press (2014).

Unit II: and

3. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
4. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry
5. Oxford, 1970
6. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
7. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India
8. Edition, 2002

Unit III:

9. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
10. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).

Course Code	OPEN ELECTIVE SEM – IV	Credits	Lectures/ Week
24 CHE VC 431	**Paper I Chemistry of commercial products used in daily life.**	**2**	**2**

CO1: Define chemical terms of commercial items used in daily life and study its properties
CO2: Understand the classification of milk, tea, coffee and cosmetics.
CO3: Apply the understandings to know the basic concepts of the components of commercial products used in daily life
CO4: Analyze adulterants in milk, tea, coffee and cosmetics.

Unit	Topics	No of Lectures
I	Composition of coffee and honey and detection of adulterants Composition of milk and tea and composition and uses. Detection of adulterants.	15
II	**Cosmetics:** Definition and Properties Properties and constituents of face powder and compact powder. Constituents and analysis of components of lipstick. **Deodorants and Antiperspirants.**Definitions Constituents and properties.	15

Reference books:

1. Analytical chemistry by C.M Mishra,D.A. Shanbaug,A.R Mehendale
2. Mann J and TruswellS(2017) : Essentials of Human Nutrition, 5th Ed. Oxford University Press.
3. Handbook of Food and Nutrition- Dr.M.Swaminathan,Bangalore Press
4. Sadasivan S and ManikamK(2007): Biochemical Methods, 3rd Ed. New Age International (P) Ltd.
5. Subalakshmi, G and Udipi, SA(2006):Food processing and preservation, 1st Ed. New Age International (P)Ltd.
6. .Kaim W, Bioinorganic Chemistry, Vol 4, Brigitte Scwederski, Wiley, 1994.
7. Crichton R. H. Biological Inorganic Chemistry – An Introduction, elsevier, 2008.
8. Berg J. M., Tymoczeko J. L., Stryer l. Biochemistry, W. H. Freeman, 2008.
9. Bertini, I., Gray, H. B., Lippard, S. J. and Valentine, J. S. (1994) Bioinorganic Chemistry. University Science Books (1994)
10. Lippard S., Berg J. M. Principles of Bioinorganic Chemistry; University Science Books 1994. 6. Polymer science, V. R. Gowariker, N. V.Viswanathan, J. Sreedhar, New Age International.

Course Code	SKILL ENHANCEMENT COURSE SEM – IV	Credits	Lectures/ Week
24 CHE SE 451	**Paper I Cosmetic Analysis and Preparations.**	**2**	**4 Hrs**

Course Outcomes:

CO1: Recall the process of neutralization and pH determination.

CO2: Understand the role of emulsifiers, preservatives, and other additives in cosmetic formulations and Develop the ability to formulate various cosmetic products. Learn the techniques for testing and evaluating the quality of cosmetic products.

CO3: Apply the basics to experience hands on training for the preparation of different types of cosmetic products.

CO4: Analyze the different types of cosmetic products & develops problem-solving and critical thinking skills to address challenges in cosmetic formulation, analysis, and production.

1	Estimation of Zn in lipstick.
2	Estimation of Mg in face powder.
3	Saponification value of oil.
4	Saponification value of acid-slurry.
5	Formulation of cold cream (water based)
6	Formulation of cold cream (oil based)
7	Preparation of liquid detergent.
8	Preparation of soap.
9	Preparation of hand sanitizer.
10	Preparation of powder detergent.
11	Preparation and formulation of shampoo.
12	Preparation and formulation of conditioner.
13	Standards and regulations for cosmetics and soap production.

14	Testing methods, quality assurance, product safety and compliance.

Reference Books:

1. "Harry's Cosmetology" by *R. Norman Harry*:
2. "The Science of Cosmetics: The Science Behind Safe, Effective Skin Care Products and Treatments" by *Paula Begoun*:
3. "Introduction to Cosmetic Formulation and Technology" by *Raymond E. Gäbelein*:
4. "Formulating, Packaging, and Marketing of Natural Cosmetic Products" by *Edgar George Hidayat*:
5. "Cosmetic Microbiology: A Practical Handbook" by *Phil Geis and Tony C. Thien*:
6. "Cosmetic Science and Technology: Theoretical Principles and Applications" by *Kazutami Sakamoto, Brian Y. Lochhead, Howard I. Maibach, and Lesley B. Stringer*:
7. "Cosmetic Formulation: Principles and Practice" by *E. Desmond Goddard and James V. Gruber*:
8. "Cosmetic and Toiletry Formulations" by *Ernest Flick*:
9. "Handbook of Cosmetic Science and Technology" edited by *André O. Barel, Marc Paye, and Howard I. Maibach*:
10. "Cosmetic Technology" by *P. K. Chattopadhyay*:
11. "Formulation and Evaluation of Cosmetic and Toiletries" by *S. M. Sontakke*:
12. "Textbook of Cosmetics" by *K. A. Shah*:
13. "Herbal Cosmetics Handbook: A Complete Guide to Manufacturing and Marketing" by *H. Panda*:
14. "Cosmetic and Toiletry Formulations" by *H. Panda*:
15. "Cosmetic Formulation: An Indian Perspective" by *R. K. Joshi*:

Course Code	Chemistry Practicals-I Major SEM III	Credits	Practical Hours /Week
24 CHE MR P 31	Practical 1	4	8 Hrs

Course Outcomes:

After successful completion of this course, students would be able to

CO1: Recall Ostwald dilution law dissociation and ionization constant.

CO2: Understand various ways of preparation of organic derivatives and Demonstrate Fundamental Principles of Chemical Equilibria.

CO3: Apply laws related to conductivity. Identify the organic compounds applying basic reaction chemistry of functional groups present.

CO4: Analyze and verify the physical parameters of weak electrolyte, structural parameters of organic compounds. Analyze Quantitative Techniques in Acid-Base Reaction.

1	To determine the amount of strong acid present in the given solution by titration with strong base conductometrically.
2	To determine the amount of strong and weak acid present in the given solution by titration with strong base conductometrically.
3	To verify Ostwald's dilution law using a weak acid.
4	To determine the degree of ionization and ionization constant of a weak acid.
5	Identification of cations in a given mixture and their separation (eight mixtures)
6	To Prepare Cyclohexanone oxime from cyclohexanone.
7	To Prepare Glucosazone from dextrose or fructose
8	To Prepare Tribromoaniline from aniline.
9	To Prepare Phthalic anhydride from phthalic acid by sublimation
10	To Prepare Acetanilide from aniline (Anhydride method)
11	To Prepare p-Bromoacetanilide from acetanilide (NBS method)
12	To Prepare Iodoform from acetone

References:

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).

4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)
5. Vogel’s textbook of organic chemistry 5th edition, B. S. Furnis and et al
6. Vogel's Textbook of Quantitative Chemical Analysis.

Course Code	SEM III -Basic Chemistry Practicals-I Minor	Credits	Practicals /Week
24 CHE MJ P 31	**Practical 1**	**2**	**4 hrs**

Course Outcomes:

After successful completion of this course, students would be able to

CO1: Recall Ostwald dilution law dissociation and ionization constant.

CO2: Understand various ways of preparation of organic derivatives and Demonstrate Fundamental Principles of Chemical Equilibria.

CO3: Apply laws related to conductivity. Identify the organic compounds applying basic reaction chemistry of functional groups present.

CO4: Analyze and verify the physical parameters of weak electrolyte, structural parameters of organic compounds. Analyze Quantitative Techniques in Acid-Base Reaction.

1	To determine the amount of strong acid present in the given solution by titration with strong base conductometrically.
2	To determine the amount of strong and weak acid present in the given solution by titration with strong base conductometrically.
3	To verify Ostwald's dilution law using a weak acid.
4	To determine the degree of ionization and ionization constant of a weak acid.
5	Estimation of cations such as Ba, Fe, Ni (Gravimetrically)
6	Estimation of Cu (complexometrically and Iodometrically)
7	To Prepare Cyclohexanone oxime from cyclohexanone.
8	To PrepareGlucosazone from dextrose or fructose
9	To PrepareTribromoaniline from aniline.
10	To Prepare Phthalic anhydride from phthalic acid by sublimation
11	To Prepare Acetanilide from aniline (Anhydride method)
12	To Prepare p-Bromoacetanilide from acetanilide (NBS method)
13	To Prepare Iodoform from acetone

References:

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).

2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).
4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)
5. Vogel's textbook of organic chemistry 5^{th} edition, B. S. Furnis and et al
6. Vogel's Textbook of Quantitative Chemical Analysis.

Course Code	SEM IV - Chemistry Practicals MAJOR	Credits	Lectures/ Week
24 CHE MJ 41	Practical 2	4	8

Course Outcomes:

After the successful completion of the practical, the learner will be able to

CO1: Remember and understand the concept of rate and the order of reaction, the basics of galvanic cells.

CO2: Understand and Implement Potentiometric and Complexometric Techniques

CO3: To apply concept of EMF to determine thermodynamic parameters

CO4: Analyze Kinetics of Chemical Reactions and Evaluate Reaction Parameters. Conduct Redox and Gravimetric Analyses to Quantify Substances. Identify and Analyze Organic Compounds Through Qualitative Analysis.

1	To determine the rate constant for hydrolysis of methyl acetate by HCl and show that it is a first order reaction.
2	To determine the rate constants of the reaction between Potassium persulphate and KI with equal initial concentrations.
3	To determine the rate constants of the reaction between Potassium persulphate and KI with unequal initial concentrations.
4	To determine the order of the reaction between Potassium persulphate and KI by fractional change method.
5	To study the effect of temperature on the rate constant of hydrolysis of methyl acetate and hence determine the energy of activation.
6	To determine standard EMF and the standard free energy change of Daniel cell potentiometrically.
7	To determine the amount of HCl in the given sample potentiometrically.
8	To determine the amount of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate.
9	Complexometric titration i) Determination of Total Hardness of water by complexometric titration. ii) Reaction between copper sulphate and sodium hydroxide Redox titration i) To determine the strength of potassium permanganate by titrating it against the standard solution of 0.1M oxalic acid. II) To determine the concentration/molarity of KMnO4 solution by titrating it against standard solution of ferrous ammonium sulphate III) To study redox reaction between Ce(IV) and Fe (II) titrimetrically

	Gravemetric analysis i) Ni (II) as Ni DMG ii) Ba as BaCrO4
10	**Organic Chemistry** Qualitative Analysis of bi-functional organic compounds on the basis of 1. Preliminary examination 2. Solubility profile 3. Detection of elements C, H, (O), N, S, X. 4. Detection of functional groups 5. Determination of physical constants (M.P/B.P) Solid or liquid Compounds containing not more than two functional groups from among the following classes may be given for analysis to be given: Carboxylic acids, phenol, carbohydrates, aldehydes, ketones, ester, amides, nitro, anilides, amines, aryl halides. Students are expected to write balanced chemical reactions wherever necessary. (Minimum 10 compounds to be analyzed)

References:

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).
4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)
5. Vogel's textbook of organic chemistry 5th edition, B. S. Furnis and et al
6. Vogel's Textbook of Quantitative Chemical Analysis

Course Code	SEM IV- Basic Chemistry Practicals-II Minor	Credits	Practicals /Week
24 CHE MR P 41	**Practical 2**	**2**	**4 Hrs**

Course Outcomes:

After the successful completion of the practical, the learner will be able to

CO1: Remember and understand the concept of rate and the order of reaction, the basics of galvanic cells.

CO2: Understand and Implement Potentiometric and Complexometric Techniques

CO3: To apply concept of EMF to determine thermodynamic parameters

CO4: Analyze Kinetics of Chemical Reactions and Evaluate Reaction Parameters. Conduct Redox and Gravimetric Analyses to Quantify Substances. Identify and Analyze Organic Compounds Through Qualitative Analysis.

1	To determine the rate constant for hydrolysis of methyl acetate by HCl and show that it is a first order reaction.
2	To determine the rate constants of the reaction between Potassium persulphate and KI with equal initial concentrations.
3	To determine the rate constants of the reaction between Potassium persulphate and KI with unequal initial concentrations.
4	To determine the order of the reaction between Potassium persulphate and KI by fractional change method.
5	To study the effect of temperature on the rate constant of hydrolysis of methyl acetate and hence determine the energy of activation.
6	To determine standard EMF and the standard free energy change of Daniel cell potentiometrically.
7	To determine the amount of HCl in the given sample potentiometrically.
8	To determine the amount of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate.
9	To determine the percentage purity of sample of $BaSO_4$ containing NH_4Cl
10	To determine the percentage purity of sample of ZnO containing $ZnCO_3$
11	To determine strength of commercial sample of acetic acid by titrimetric method
12	To determine strength of commercial sample of HCl by titrimetric method

13	**Organic Chemistry** Qualitative Analysis of bi-functional organic compounds on the basis of 1. Prelimenary examination 2. Solubility profile 3. Detection of elements C, H, (O), N, S, X. 4. Detection of functional groups 5. Determination of physical constants (M.P/B.P) Solid or liquid Compounds containing not more than two functional groups from among the following classes may be given for analysis to be given: Carboxylic acids, phenol, carbohydrates, aldehydes, ketones, ester, amides, nitro, anilides, amines, aryl halides. Students are expected to write balanced chemical reactions wherever necessary. (Minimum 6 compounds to be analyzed)

References:

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi (2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rd Ed., W.H. Freeman and Co., New York (2003).
4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001)
5. Vogel's textbook of organic chemistry 5th edition, B. S. Furnis and et al
6. Vogel's Textbook of Quantitative Chemical Analysis

Evaluation Scheme for Second Year (UG) under NEP (2 credits)

I. Internal Evaluation for Theory Courses – 20 Marks

1) Continuous Internal Assessment(CIA) Assignment - Tutorial/ Case Study/ Project / Presentations/ Group Discussion / Ind. Visit. – 10 marks

2) Continuous Internal Assessment(CIA) ONLINE Unit Test – 10 marks

II. External Examination for Theory Courses – 30 Marks

Duration: 2 Hours

Theory question paper pattern:

Question	Based on	Marks
Q.1	Unit I	10
Q.2	Unit II	10
Q.3	Unit III	10

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be sub-divided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.

III. Practical Examination

- Each core subject carries 50 Marks
- Duration: 3 Hours for each practical course.
- Minimum 80% practical from each core subjects are required to be completed.
- Certified Journal is compulsory for appearing at the time of Practical Exam

NOTE: To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examinations.

Evaluation Scheme for Second Year (UG) under NEP (2 credits)

I. Internal Evaluation for Theory Courses – 20 Marks

1) Continuous Internal Assessment(CIA) Assignment - Tutorial/ Case Study/ Project / Presentations/ Group Discussion / Ind. Visit. – 10 marks

2) Continuous Internal Assessment(CIA) ONLINE Unit Test – 10 marks

II. External Examination for Theory Courses – 30 Marks

Duration: 1 Hours

Theory question paper pattern: All questions are compulsory.

Question	Based on	Marks
Q.1	Unit I	10
Q.2	Unit II	10
Q.3	Unit III	10

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be sub-divided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.

III. Practical Examination

- Each core subject carries 50 Marks.
- Duration: 2 Hours for each practical course.
- Minimum 80% practical from each core subjects are required to be completed.
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NOTE: To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examinations.