SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
(Engineering College), VIDISHA M.P.
(An Autonomous Institute Affiliated to Barkatullah Vishwavidyalaya, Bhopal)

Department of Applied Chemistry
Ordinance No 14(2)
Syllabus For M Sc Applied Chemistry Program (I Semester) w.e.f. 2025-26
As per NEP 2020

Subject Category	**CC**	**Subject Code**	**MAC 2511**	**Subject Name**	**Physical Chemistry**			
Maximum Marks Allotted				Total Marks	Duration of End Sem Exam	Contact Hours per Week		Total Credits
Theory								
End Sem	Mid-Sem	Quiz	Assignment	100	3 Hrs	L	T	
60	20	10	10			3	1	4

Prerequisites:

As per Ordinance No 14(2)

Course Objective:

The primary objective of this course is to equip students with a strong foundation in physical chemistry principles.Enable them to address challenges in teaching, research, and industry.Foster critical analysis and scientific interpretation of chemistry related problemsacross academic and professional settings.

Course Outcomes:

Students after successful completion of course will develop the ability to think critically and analytically in addressing complex chemical problems encountered in teaching, research, and industrial contexts. They will be expected to approach these problems with a scientific perspective, employing theoretical knowledge and logical reasoning.

CO's	**CO's Description**
	After going through this course, the students will be able to
CO1	Understand core thermodynamic concepts and laws to analyse energy, entropy, and Gibbs free energy. Apply these principles through problem-solving to strengthen theoretical understanding
CO2	Understand the principles of chemical kinetics, catalysis, and photochemistry; analyse reaction rate theories, temperature & catalyst effects, and photochemical laws.Apply these concepts to reaction mechanisms, equilibrium, and industrial applications
CO3	Understand the fundamental principles of electrochemistry, analyse electrode potentials, EMF of cells, and the working of energy storage systems like lithium-ion batteries.
CO4	Understand corrosion processes, influencing factors, and protective methods such as control techniques and coatings
CO5	Understand surface chemistry through colloids, micelles, and adsorption; assess their properties and isotherms; and apply them in practical and industrial contexts.

UNIT	Descriptions	Hrs.	CO's	Remarks
I	**UNIT I - CHEMICAL THERMODYNAMICS** **Chemical Thermodynamics:** Introduction, Thermodynamic Laws: Zeroth Law; 1st law of thermodynamics: Concept of Internal energy &Enthalpy, Joule Thomson Effect; 2nd law of thermodynamics: Carnot theorem and Carnot cycle, Physical Significance of Entropy, Work function and Gibbs free energy, Gibb's Helmholtz equation and its	8	1	

	applications, Thermodynamic derivation of law of mass action, Vant Hoff's isotherm and isochore, Clausius-Clapeyron equation and its applications; 3rd law of thermodynamics: Statement of 3rd law of thermodynamics, Residual entropy.Numerical problems.			
II	**UNIT II - CHEMICAL KINETICS** **Chemical Kinetics**: Introduction, Rate expression, Order and molecularity of reaction, Theories of reaction rates, Unimolecular theory, Bimolecular theory: Collision and Transition state theory, Arrhenius equation, Effect of temperature and catalyst on reaction rate.**Catalysis**: Theories of catalysis, Enzyme catalysis, Acid and Base catalysed reactions. **Photochemistry**: Introduction of photochemistry, Laws of photochemistry, Quantum Yield, Photochemical reactions and its kinetics, Photo-stationary state, Photochemical equilibrium, Molecular excitation (Jablonski Diagram), Luminescence, Photosensitization.	8	2	
III	**UNIT III - ELECTROCHEMISTRY** **Electrochemistry**: Redox Reactions, Oxidation number, Oxidising and reducing agents, Electrochemical series, Feasibility of redox change, Electrochemical cell, Cell notation, Electrode potential, Reversible electrodes and its type, Derivation of Nernst equation, Derivation of single electrode potential, Primary (SHE) and Secondary Reference electrodes (Calomel & Ag-AgCl electrode), The laws of electrolysis, Electrolytic cells, Discharge potential.Numerical problems. **Energy storage system**: Introduction, classification of batteries, Construction, working and applications of lithium ion batteries, Recycling of lithium-ion battery, Brief introduction of Na-ion battery.	8	3	
IV	**UNIT IV – CORROSION & PROTECTION OF METALS** Introduction, Causes of corrosion, Disadvantages, Types and Mechanism of corrosion, Classification of dry and wet corrosion, Passivity, Factors influencing the rate of corrosion, Protective methods of Corrosion: Modification of Environmental, Design of material, Cathodic &Anodic Protection Method, Protective Coatings: Metallic coatings (Galvanisation, Tinning, Electroplating, Metal Clading) & Organic Coatings (Paints, Varnishes).	8	4	
V	**UNIT V - SURFACE CHEMISTRY** **Colloids and Colloidal State**: Classification,Origin of charge on colloids, Stability, Preparation,& Properties of colloids, Precipitation and coagulation of colloids, Donnan membrane equilibrium and its applications.Micelles: Surface active agents, Classification of surface-active agents, Micellization, critical micellar concentration (CMC), factors affecting the CMC of surfactants. **Adsorption and Adsorption Isotherms:** Introduction, Typesof Adsorption, Factors affecting adsorption of gases on solids, Adsorption Isotherms, Freundlich Adsorption Isotherm, Langmuir Adsorption Isotherm, BET theory for multilayer adsorption, Adsorption of solids on liquids: Gibbs adsorption Isotherm, Applications of adsorption.	8	5	
Total Hours		40		

TEXT BOOKS:

- Atkins' Physical Chemistry by Peter Atkins & Julio de Paula.
- Engineering Chemistry - Jain & Jain - DhanpatRai&Company Pvt. Ltd, New Delhi.
- A Text Book of Engineering Chemistry - S.S. Dara - S. Chand Publication, Delhi.
- O.G. Palanna, McGraw Hill Education (India) Private Limited, 9th Reprint, 2015.
- P. C. Rakshit, Physical Chemistry, 7th Edition, Sarat Book Distributors, Kolkata, 2004.

REFERENCE BOOKS:

- Principles of Physical Chemistry by Puri, Sharma &Pathania.
- Elements of Physical Chemistry by Peter Atkins & Julio de Paula.
- Thermodynamics for Chemists by S. Glasstone.
- A Textbook of Physical Chemistry by K L Kapoor.
- Chemical Kinetics by K J Laidler.
- Corrosion and its Control, 3rd Ed., H.H. Uhlig and R.W. Revie, John Wiley, Singapore, 1991.
- Principles of Adsorption and Adsorption Processes – Douglas M Ruthven.

Modes of Evaluation and Rubric

Evaluation will be continuous as an integral part of the class as well through external assessment. Laboratory assessment will be based on assignments, presentations, and viva of each candidate.

List/Links of e-learning resource

- https://nptel.ac.in/courses/112105123.
- https://nptel.ac.in/courses/104106089.
- https://onlinecourses.nptel.ac.in/noc24_cy10/preview.
- https://onlinecourses.nptel.ac.in › preview.
- https://onlinecourses.nptel.ac.in/noc24_ch47/preview.
- https://nptel.ac.in/courses/103101141.

Recommendation by Board of studies on	**11.6.2025 (Wednesday)**
Approval by Academic council on	**11.6.2025 (Wednesday)**
Subject handled by department	**Applied Science Chemistry**

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Syllabus For M Sc Applied Chemistry Program (I Semester) w.e.f. 2025-26

As per NEP 2020

Subject Category	**CC**	**Subject Code**	**MAC 2512**	**Subject Name**	**Inorganic Chemistry**		
Maximum Marks Allotted				Total Marks	Duration of End Sem Exam	Contact Hours per Week	Total Credits
Theory							
End Sem	Mid-Sem	Quiz	Assignment	100	3 Hrs	L T	
60	20	10	10			3 1	4

Prerequisites:

As per Ordinance No 14(2)

Course Objective:

The main aim of this course is to make Students familiar with basic concepts of Inorganic Chemistry, the students face in academics, research, and industrial sector. With this background the students will be able to explain scientifically the various chemistry related problems in academics, research and industrial sector.

Course Outcomes:

This course covers atomic structure, chemical bonding, and periodic trends using quantum concepts and bonding theories. It explores the properties of transition metals, lanthanides, and actinides, along with coordination chemistry and organometallic compounds, emphasizing structure, bonding, and catalytic applications.

CO's	**CO's Description**
	After going through this course, the students will be able to
CO1	Understand atomic models, quantum principles, and electron configurations. Explain typesof chemical bonds and apply bonding theories and hybridization to predict molecularstructure and properties.
CO2	Analyse periodic trends including effective nuclear charge, atomic and ionic radii,ionization enthalpy, electron affinity, and electronegativity to explain element behaviour across s, p, d, and f blocks.
CO3	Describe electronic configurations, oxidation states, and properties of transition metals, lanthanides, and actinides, emphasizing their colour, magnetism, catalytic activity, and lanthanide contraction.
CO4	Classify coordination compounds and ligands, and apply bonding theories to explain theirstructures, magnetic and spectral properties, and advanced concepts like crystal fieldeffects and stereochemistry.
CO5	Define and classify organometallic compounds, analyse key structures and electroncounting, and understand their catalytic roles in processes such as hydrogenation andFischer-Tropsch synthesis, etc.

UNIT	Descriptions	Hrs.	CO's	Remarks
I	**UNIT I-ATOMIC STRUCTURE AND CHEMICAL BONDING**	8	1	

	Atomic Structure: Introduction, Atomic Models of atom, Bohr's Theory and its limitation, atomic spectra of hydrogen atom, de Broglie equation,Heisenberg's Uncertainty Principle and its significance, Quantummechanical model of atom, Quantum numbers and their significance,shapes of s, p, d, and, f orbitals, Nodes and their types, Filling ofOrbital's in atom: Aufbau principle and its limitations, Pauli's ExclusionsPrinciple, Hund's rule of maximum multiplicity. **Chemical Bonding:**Types of Bonding (Ionic Bond, Covalent Bond, Metallic Bond and Weak Chemical Forces), Theories on Bonding: Valence Shell Electron Pair Repulsion Theory (VSEPR Theory), Valence Bond Theory (VBT), Molecular Orbital Theory (MOT), Hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements, Molecular orbital diagrams of diatomic and polyatomic molecules, Fajans Rule.			
II	**UNIT II -CHEMICAL PERIODICITY** Modern periodic table, detailed discussion of the following properties of the elements, with reference to s, p, d & f-blocks. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) Covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) Electron affinity, (g) Electronegativity, Pauling's/ Mulliken's electronegativity scales.	8	2	
III	**UNIT III- TRANSITION AND INNER TRANSITION METAL CHEMISTRY** General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, and ability to form complexes. Stability of various oxidation states. **Lanthanides**: Electronic configuration, oxidation states, colour, spectral and magnetic properties,chemical reactivity, lanthanide contraction. **Actinides**: Electronic configuration, oxidation states and comparison with lanthanides.	8	3	
IV	**UNIT IV - COORDINATION CHEMISTRY** Introduction, Classification of ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of coordination compounds, Stereochemistry of coordination compounds, Werner's theory, valence bond theory, Crystal field theory, Chelate effect, Labile and inert complexes, , electro-neutrality principle and back bonding, 18 electron rule, , measurement of CFSE, weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq in octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry, Jahn-Teller theorem, square planar geometry.	8	4	
V	**UNIT V - ORGANOMETALLIC COMPOUNDS** Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands, **Metal carbonyls**:	8	5	

	electron count of mononuclear, polynuclear and substituted metal carbonyls, Structures of methyl lithium, Zeiss's salt andFerrocene, EAN rule. Catalysis by Organometallic Compounds: Alkene hydrogenation (Wilkinson's Catalyst), and Synthetic gasoline (Fischer Tropsch reaction).			
Total Hours		40		

TEXT BOOKS:

- Lee J. D., Concise Inorganic Chemistry, Wiley India, 5th Edn., 2008.
- Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry - Principles of structure and reactivity, Pearson Education, 4th Ed. 2002.
- Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
- Shriver D. E.,Atkins P. W., InorganicChemistry, Oxford University Press,5thEdn.
- Svehla, G. Vogel's Qualitative Inorganic Analysis, 7th Edition, Prentice Hall, 1996-0307.

REFERENCE BOOKS:

- Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.
- Bioinorganic Chemistry, Asim Kumar Das, Books & Allied (P) Ltd. 1st ed. 2015.
- Selected Topic in Inorganic Chemistry, Mallick, Madan and Tuli, S. Chand Publications.
- Selected Topic in Inorganic Chemistry, Mallick, Madan and Tuli, S. Chand Publisher 17th Ed. 2010.
- Mehrotra R.C. and Singh, A. Organometallic Chemistry, New Age International Publishers, 2ndEdn, 2000.
- Gupta B. D. and Elias A. J., Basic organometallic Chemistry, 2nd Edn., University Press (2013).

Modes of Evaluation and Rubric

Evaluation will be continuous as an integral part of the class as well through external assessment. Laboratory assessment will be based on assignments, presentations, and viva of each candidate.

List/Links of e-learning resource

- https://onlinecourses.nptel.ac.in/noc25_cy63/preview
- https://nptel.ac.in/courses/104101091
- https://nptel.ac.in/courses/104101121 , https://onlinecourses.nptel.ac.in/noc25_cy05/preview
- https://nptel.ac.in/courses/104101090 , https://onlinecourses.nptel.ac.in/noc25_cy10/preview
- https://nptel.ac.in/courses/104105085, https://onlinecourses.nptel.ac.in/noc25_cy11/preview.

Recommendation by Board of studies on	**11.6.2025 (Wednesday)**
Approval by Academic council on	**11.6.2025 (Wednesday)**
Subject handled by department	**Applied Chemistry**

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Syllabus For M Sc Applied Chemistry Program (I Semester) w.e.f. 2025-26

As per NEP 2020

Subject Category	**CC**	**Subject Code**	**MAC 2513**	**Subject Name**	**Natural Products**			
Maximum Marks Allotted				Total Marks	Duration of End Sem Exam	Contact Hours per Week		Total Credits
Theory								
End Sem	Mid-Sem	Quiz	Assignment	100	3 Hrs	L	T	
60	20	10	10			3	1	4

Prerequisites:

As per Ordinance No 14(2)

Course Objective:

The objective of M.Sc. Applied Chemistry program is to provide students with a comprehensive understanding of chemical principles and their practical applications across various industries and research areas. This includes developing skills in research, analysis and problem-solving within the field of chemistry as well as preparing students for careers in diverse sectors like chemical industries, pharma industries, research organizations, refineries and many more fields.

Course Outcomes:

M.Sc. in Applied Chemistry equips students with advanced knowledge and practical skills in various chemical disciplines, including organic, inorganic, physical, analytical and industrial chemistry. Syllabus typically covers the isolation, structure determination, synthesis and biosynthesis of various classes of natural products including Alkaloids, Terpenoids, Steroids,Flavanoids and Carbohydrates, Proteins, Vitamins etc.

CO's	**CO's Description**
	After going through this course, the students will be able to
CO1	Classify natural products according to their chemical structure, their occurrence and to suggest their possible biosynthetic pathways for new drug discovery.
CO2	Design the appropriate strategy to isolate and characterize different class of natural products such as alkaloids &flavonoids.
CO3	The exposure to high levels of steroidal hormones disrupts normal endocrine function and decreases fertility and other disease in mammals including humans.
CO4	To study proteins and vitamins which reveals their crucial roles in human health, impacting various bodily functions and potentially influencing disease outcomes.
CO5	To study proper functioning of many enzymes involved in the metabolism of carbohydrates, DNA, and other bio-molecules and they play a critical role in maintaining cellular health and function.

UNIT	Descriptions	Hrs.	CO's	Remarks
I	**Unit I - IMPORTANCE OF NATURAL PRODUCTS IN NEW DRUG DISCOVERY** **Natural Products**: Introduction, classification, sources & nomenclature	8	1	

	of natural products, general methods of structural elucidation. **Terpenoids:** Introduction, classification & isoprene rule and structure determination for terpenoids, significances of natural products in new drug discovery.			
II	**Unit –II ALKALODS & FLAVANOIDS** **Alkaloids:** Introduction, Nomenclature &Cassification of Alkaloids, structure elucidation, properties and uses of Atropine, Quinine, Morphene &Caffeine. **Flavanoids:** Introduction, Nomenclature, Classification, and Isolation ofFlavonoids, Flavones, Isoflavones, Flavanones &Anthocyanidins.	8	2	
III	**Unit –III STEROIDS & HORMONES** Introduction, Occurrence, Nomenclature, &Classification, Basic skeleton of Steroids, Diel's hydrocarbon, Isolation, Structure determination and biosynthesis of Cholesterol, Testosterone, Progesterone, Estrogen & Bile acids.	8	3	
IV	**Unit –IV PROTEINS & VITAMINS** **Proteins:** Introduction, classification of proteins, structure of fibrous & globular proteins, components of proteins, significance of proteins for human health. **Vitamins:**Occurrence, Nomenclature and Classification of Vitamins, Structure, Synthesis &Chemistry of Vitamin A,B,C,D,E,& K, Antivitamins, Provitamins, Significance of Vitamins.	8	4	
V	**Unit –V PHARMACEUTICAL BIOCHEMISTRY** Biochemistry & its importance of pharmaceutical science, enzyme, carbohydrate, lipids, nucleic acid metabolism (DNA & RNA), enzyme immobilization, recombinant DNA technology.	8	5	
Total Hours		40		

TEXT BOOKS:

- Chemistry of Natural Products, Sujata V.Bhat, B.A.Nagasampagi, Meenakshi Sivakumar, Springer**.**
- The Chemistry of Natural Products, R.H.Thomson,Springer.
- Bioactive Natural Products,Chemistry and Biology,Goutam Brahmachari,Wiley India Pvt.Ltd.
- Organic Chemistry Vol.II,1,1Finar,Pearson Education India.
- Medicinal Chemistry,Alfred Burgir,Wiley Inter.Pub.
- Medicinal Natural Products: A Biosynthetic Approach,3rd Edition,P.M.Dewick,2009,John Wiley & Sons Ltd.
- Pharmacognosy,Fourth Edition,C.K Kokate,2005,Nirali Prakashan,Pune.
- Chemistry of plant Natural Products:Stereochemistry,Conformation, synthesis, Biology& Medicine,S.K.Talapatra,2015,Springer.

REFERENCE BOOKS:

- Chemistry of Natural Products,Vol. I,II,O.P.Agarwal,Goel Pub.Meerut.
- Chemistry of Natural Products,Vol, I,II,Chatwal Anand,Himalaya Pub.
- Trease & Evan's Pharmacognosy,16th Edition,W.C.Evans,2009,Elsevier.

- Chemistry of Natural products,1st Edition, S.V.Bhat,B.A.Nagasampagi & M.Sivakumar,2008,Narosa Publishing House.
- Pharmacognosy,Phytochemistry,Medicinal plants,2nd Edition,Jean Bruneton,1999,Intercept Ltd.New York.
- G. F. M. Ball. 2004. Vitamins: Their Role in the Human Body. John Wiley & Sons.
- R. B. Rucker, J. Zempleni, J. Suttie, and D. McCormick, eds. 2007. Handbook of Vitamins. 4th ed. Taylor & Francis.

Modes of Evaluation and Rubric

Evaluation will be continuous as an integral part of the class as well through external assessment. Laboratory assessment will be based on assignments, presentations, and viva of each candidate.

List/Links of e-learning resource

- natprod@imedpublisher.com
- https.//nptel.ac.in/course.html
- https//iln.ieee.org/resources/e-learning
- https//learnchem.com

Recommendation by Board of studies on	**11.6.2025 (Wednesday)**
Approval by Academic council on	**11.6.2025 (Wednesday)**
Subject handled by department	**Applied Chemistry**

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Syllabus For M Sc Applied Chemistry Program (I Semester) w.e.f. 2025-26

(As per NEP 2020)

Subject Category	**CC**	**Subject Code**	**MAC 2514**	**Subject Name**	**Analytical Chemistry**

Maximum Marks Allotted				Total Marks	Duration of End Sem Exam	Contact Hours per Week		Total Credits
Theory								
End Sem	Mid-Sem	Quiz	Assignment	100	3 Hrs	L	T	
60	20	10	10			3	1	4

Prerequisites:

As per Ordinance No 14(2)

Course Objective:

The main aim of Analytical Chemistry is to make Students familiar with basic concepts of Analytical Chemistry, the students face in industry and academic field. With this background the students will be able to explain Scientifically the various analytical chemistry related problems in industry and academia.

Course Outcomes:

Students after successful completion of course shall possess skills to think critically and analyse the problems in Industry, R & D and academic field. Laboratory work is intended for students to learn conducting experiments and analyse experimental data.

CO's	**CO's Description**
	After going through this course, the students will be able to
CO1	Know fundamental concepts, importance, types of Analytical Chemistry.
CO2	Know the methods of expressing concentration of solutions, how to prepare different solutions theoretically.
CO3	Know basic knowledge of theoretical concepts of volumetric techniques.
CO4	Understand the theoretical principles of Redox and Complexometric titrations, including the use of indicators and titration methods, and to develop problem-solving skills through related numerical calculations.
CO5	Understand the types, sources, and minimization of errors in chemical analysis, and to develop the ability to evaluate precision and accuracy using statistical tools and numerical problem-solving.

UNIT	**Descriptions**	Hrs.	CO's	Remarks
I	**UNIT I -SCOPE & IMPORTANCE OF ANALYTICAL CHEMISTRY** **Role of Analytical Chemistry:** Importance, Applications and Scope of Analytical Chemistry, Classification of Analytical methods (Classical and Instrumental), Selection of method for analysis **Sampling:** Terms involved in sampling, purpose of sampling, Types of sampling, Difficulties encountered in Sampling	8	1	

	Safety Measures: Introduction, Safety measures in laboratory, Types of Hazards, Types of Fire Extinguishers and their use **Measurement system:** Definitions of seven base units, Derived units, conversion between units, significant figures. Numerical problems.			
II	**UNIT II- PRELIMINARY OPERATIONS IN ANALYTICAL CHEMISTRY** **Errors in Analysis:** Types and classification of errors. Constant and proportionate errors. Determinate errors and Indeterminate errors, Absolute error and Relative error. **Precision and Accuracy:** Concept of Precision and Accuracy, Evaluation involved in Precision and Accuracy, Calibration of apparatus, Control determination, blank determination. **Concentration Expression of Solutions:** Mole, Equivalent weight, molar mass, calculations in grams and moles, solutions and their concentrations, molar concentration, Normal concentration, Percent concentration, Parts Per Million (ppm), Parts Per Billion (ppb), Volume ratio for dilution procedures. Numerical problems.	8	2	
III	**UNIT III- TITRIMETRIC ANALYSIS-I (ACID BASE TITRATIONS AND PRECIPITATION TITRATIONS)** **Terms Involved in Titrimetric Methods:** Definition of terms- Titrant, Titrand, Titration, End point and Equivalence point, Indicator, Standard solution, Primary Standard and Secondary Standard, Conditions suitable for titrimetry, Blank Titration, Back Titration. Types of Titration **Acid-Base titration:** Theory of acid base indicators, Theory of acid-base titration, Titration Curves, Titration of Strong acid-Strong base, Weak acid-Strong base, Strong acid-Weak base, Weak acid-Weak base with titration curve and choice of indictors. **Precipitation Titration:** Concept of precipitation, Titration curve for precipitation reaction, end point detection, Mohr's method and Volhard's method. Numerical problems.	8	3	
IV	**UNIT IV- TITRIMETRIC ANALYSIS-II (REDOX TITRATIONS & COMPLEXOMETRIC TITRATIONS)** **Redox Titration:** Theoretical basis of Redox volumetric analysis involving (i) Potassium Permanganate (ii) Potassium dichromate and (iii) Iodine. **Complexometric Titration:** Theory of Complexometric Titration, Indicators for EDTA titration, Types of EDTA titration-Direct and Back titration. Numerical problems.	8	4	

V	**UNIT V - GRAVIMETRIC ANALYSIS:** **General:** Introduction, Theory of gravimetric analysis, Concept of Solubility and Solubility Product, completeness of Precipitation. **Properties of Precipitates:** Precipitation process and particle size, Machines of precipitate formation, nucleation and crystal growth, colloidal state, ageing of precipitates. **Purity of Precipitate:** Simultaneous precipitation, Co precipitation Post precipitation, Precipitation from homogenous solutions, Washing, drying and ignition of precipitate, Thermo gravimetric analysis, classification, Factors affecting TG curve Numerical problems.	8	5	
Total Hours		40		

TEXT BOOKS:

- D. A. Skoog et al. Fundamentals of Analytical Chemistry.
- M. Otto. Chemometrics: Statistics and Computer Applications in Analytical Chemistry.
- Manz and H. Becker, Eds. Microsystem Technology in Chemistry and Life Sciences.
- R. Willoughby et al. A Global View of LC/MS: How to Solve Your Most Challenging Analytical Problems.
- G. Christian. Analytical Chemistry: Solutions Manual.

REFERENCE BOOKS:

- Instrumental Method – Skoog, Holler & Crouch.
- Dean. Analytical Chemistry Handbook.
- G. W. Ewing. Analytical.
- Instrumentation: A Laboratory Guide for Chemical Analysis.
- D. Harvey. Modern Analytical Chemistry.
- J. N. Miller. Modern Analytical Chemistry.
- T. J. Bruno. Spectroscopic Methods.

Modes of Evaluation and Rubric

Evaluation will be continuous as an integral part of the class as well through external assessment. Laboratory assessment will be based on assignments, presentations, and viva of each candidate.

List/Links of e-learning resource

- NIST Chemistry Webbook
  http://webbook.nist.gov
- {Analytical Chemistry Springboard from Umeå University}
  http://www.anachem.umu.se/jumpstation.htm

Recommendation by Board of studies on	**11.6.2025 (Wednesday)**
Approval by Academic council on	**11.6.2025 (Wednesday)**
Subject handled by department	**Applied Chemistry**

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As per NEP 2020

Subject Category	**PC**	**Subject Code:**	**MAC 2515**	**Subject Name**	**Practical Chemistry - I**		
Maximum Marks Allotted				Total Marks	Duration of End Sem Exam	Contact Hours per Week	Total Credits
Practical							
End Sem	Lab-Work	Quiz		100	6 Hrs	12	4
60	30	10					

Prerequisites:

As per Ordinance No 14(2)

Course Objective:

This course aims to develop students' practical skills in volumetric analysis through various titration techniques, including Redox, Acid-Base, Complexometric, Iodometric, and Precipitation methods. It emphasizes accurate solution preparation, indicator use, and determination of chemical concentrations in water, alloys, and industrial samples.

Course Outcomes:

Students after successful completion of these practicals will be able to accurately perform various titration techniques to analyse chemical substances, determine concentrations, and interpret results. They will gain hands-on experience in laboratory procedures, solution preparation, and the proper use of indicators and instruments.

CO's	**CO's Description**
	After going through this course, the students will be able to
CO1	Demonstrate proper laboratory safety protocols and accurate handling, calibration, and usage of common glassware and instruments such as burettes, pipettes, measuring cylinders, and chemical balances.
CO2	Conduct redox titrations using internal, external, and self-indicators (e.g., DPA, $KMnO_4$, $K_4[Fe(CN)_6]$) to determine the concentration of unknown solutions like Mohr's salt and iron in steel, and interpret the results accurately.
CO3	Apply Complexometric titration techniques using EDTA to assess water hardness, and perform acid-base titrations using various indicators to determine the composition and properties (alkalinity, acidity, carbonate/bicarbonate content) of water and alkaline solutions.
CO4	Carry out Iodometric titrations for estimating copper content in compounds and materials (e.g., wires, brass, bronze) and perform precipitation titrations for chloride ion analysis using silver nitrate and chromate indicators.
CO5	Analyze and interpret titration data to evaluate chemical composition in industrial and environmental samples, fostering critical thinking and problem-solving skills applicable to real-world chemical analysis.

Suggestive list of experiments:

Suggested List of Practicals (Minimum 12 Experiments be performed):

1. Introduction to chemistry lab, Safety Measures, Calibration of glass-wares i.e. Chemical balance, burette, pipette, measuring cylinders.
2. To prepare 0.1 N solution of NaOH and 0.1 N solution of HCl.

3. Determination of strength of NaOH solution by titrating it against a standard solution of Oxalic acid.
4. To determine strength of Sodium Carbonate and Sodium Bicarbonate in given alkaline solution by titrating with standard HCl using phenolphthalein and Methyl Orange indicators. [Acid Base Titration]
5. To determine strength of Sodium Carbonate and Sodium hydroxide in given alkaline solution by titrating with standard HCl using phenolphthalein and Methyl Orange indicators. [Acid Base Titration]
6. To determine free CO_2 in given water sample. [Acid Base Titration]
7. To determine acidity in given water sample using Phenolphthalein and Methyl Orange indicators. [Acid Base Titration]
8. To determine alkalinity in given water sample using Phenolphthalein and Methyl Orange indicators. [Acid Base Titration]
9. Determination of total solids dried at 103-105^{o}C. [Gravimetric estimation]
10. Determination of total dissolved solids (TDS) dried at 180^{o}C. [Gravimetric estimation]
11. To determine Temporary, Permanent and Total Hardness in given sample of water by E.D.T.A. method.[Complexometric Titration]
12. To determine amount of Ca and Mg in given sample of water. [Complexometric Titration]
13. To determine the chloride content of the given sample of water using silver nitrate solution with potassium chromate solution as an indicator.[Precipitation Titration]
14. To determine strength of unknown Ferrous Ammonium Sulphate $FeSO_4.(NH_4)_2SO_4.6H_2O$ (Mohr's Salt) solution by titrating it against intermediate Potassium Dichromate ($K_2Cr_2O_7$) solution using Di Phenyl Amine (DPA) (internal indicator). [Redox Titration]
15. To determine strength of FAS solution by titrating it against intermediate Potassium permanganate ($KMnO_4$)solution. (Self Indicator). [Redox Titration]
16. To determine strength of unknown Ferrous Ammonium Sulphate $FeSO_4(NH_4)_2SO_4.6H_2O$ (Mohr's Salt) solution by titrating it against intermediate Potassium Dichromate ($K_2Cr_2O_7$) solution using potassium ferricyanide indicator (External Indicator). [Redox Titration]
17. Determination of percentage of Fe in steel using DPA indicator. [Redox Titration]
18. To determine strength of unknown $CuSO_4$ solution by titrating it against intermediate sodium thiosulphate (Hypo) solution using starch as final indicator. [Iodometric Titration]
19. Determination of strength of Cu in electric wire. [Iodometric Titration]
20. Determination of strength of Cu in (1) Brass and (2) Bronze sample. [Iodometric Titration]
21. To determine the amount of available chlorine in given sample of Bleaching powder. [Iodometric Titration]
22. Any other experiment proposed by department

Recommendation by Board of studies on	**11.6.2025 (Wednesday)**
Approval by Academic council on	**11.6.2025 (Wednesday)**
Subject handled by department	**Applied Chemistry**