M G Science Institute, Ahmedabad

(Autonomous college affiliated to Gujarat University)

B. Sc. in Chemistry

(Faculty of Science)

New Syllabus of

T. Y. B. Sc. Chemistry

(As Per National Education Policy- 2020)

To be implemented from Academic Year 2026-27

Board of Studies (Chemistry)

M G Science Institute, Ahmedabad

Autonomous college affiliated to Gujarat University

Programme Educational Objectives (PEOs)

The UG degree in Chemistry aims to provide:

1. Our graduates will get knowledge and skills in different branches of Chemistry and related interdisciplinary areas thereby enhancing students' employability/ entrepreneurship.
2. Our graduates will achieve depth knowledge in Chemistry through understanding of key concepts, principles, theories and their manifestations.
3. Our graduates will gain critical and analytical thinking, scientific reasoning, creativity, problem-solving skills, communication skills and teamwork.
4. Our graduates will be advance in competence and skill in solving both theoretical, practical and applied problems.
5. Our graduates will get exposure to the latest advances in chemistry, allied disciplines and research.
6. Our graduates will more inculcate and advance in digital skills in Chemistry, interdisciplinary areas and Indian knowledge system.
7. Our graduates will be rich in moral and ethical awareness, value education leadership qualities, innovation, life-long learning and more responsible for community engagement and service
8. Our graduates will have successful careers in industry, government, academic and research institutions with a commitment to continuous learning and professional development.

Programme Outcomes (POs)

After the completion of Bachelor Programme, Students will be able to-

PO-1. Gain a thorough knowledge, understanding of fundamental concepts and Principle of various branches of basic and applied science
PO-2. Communicate the knowledge of subject in a clear and simple manner in writing and oral.
PO-3. Identify the given problem and apply, theories/assumptions for solving the same.
PO -4. Exhibit skills leading to employability in various industries and PSUs.
PO-5. Plan, execute, interpret, analyse and report the results of the experiments to investigate.
PO-6. Work effectively and respectfully as a team member in the classroom, laboratory and field-based situations.
PO-7. Comprehend the fundamental aspects of research in various discipline of basic science.
PO-8. Possess the level of proficiency in subject required for post-graduation as well as for pursuing research in various discipline of basic science and applied science and related interdisciplinary subjects.

Programme Specific Outcomes (PSOs)

After completing the Bachelor of Science in Chemistry, students will be able to-

PSO -1. Learn the basic terms, theories, principles of Chemistry and its various branches.
PSO -2. Identify and solve the problems and issues with well-defined solutions.
PSO -3. Get hands-on training of the chemistry related equipment.
PSO -4. Use modern techniques, software's, web resources and AI based techniques.
PSO -5. Create awareness about the impact of chemistry on the environment, in and outside the scientific society.
PSO -6. Know and understand the safety rules of Chemistry required for working in and outside the laboratory.

List of courses for T. Y. B. Sc. Chemistry

Semester –V

A. Discipline Specific Courses - Core (Major)
1. CHM351(T): Organic chemistry (4 Credit)
1. CHM352(T): Analytical Spectroscopic Techniques (4 Credit)
2. CHM353(P): Chemistry Practical (4 Credit)

B. Discipline Specific Courses – Minor
1. CHE354(T): Inorganic and Physico chemical science
2. CHE355(P): Chemistry Practical (4 Credit)

C. Skill Enhancement Course (SEC)
CHSEC356 (T): Industrial applications in chemistry (2T)

Semester –VI

A. Discipline Specific Courses - Core (Major)
1. CHM361(T): Inorganic chemistry (4 Credit)
1. CHM362(T): Physical chemistry (4 Credit)
2. CHM363(P): Chemistry Practical (4 Credit)

B. Discipline Specific Courses – Minor
CHE364(T+P): Organoanlytical chemistry (2T+2P)

Internship – 4 credit

Syllabus of Courses

M G Science Institute, Ahmedabad
(Autonomous college affiliated to Gujarat University)
B. Sc. SEMESTER V
CHEMISTRY
EFFECTIVE FROM – JUNE 2026
ACCORDING TO NEP - 2020
Course Structure with respect to credit, hours and marks for Sem - V

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline specific Courses – Core (Major)	CHM351(T): Organic Chemistry	4(T)	4	2.5	50	50	100
	CHM352(T): Analytical Spectroscopic Techniques	4(T)	4	2.5	50	50	100
	CHM353(P): Chemistry Practical	4(P)	8	6.0	50	50	100
Discipline Specific Courses – Minor	CHE354(T): Inorganic and Physico chemical science	4(T)	4	2.5	50	50	100
	CHE355(P): Chemistry Practical	4(P)	8	9.0	50	50	100
Skill Enhancement course	CHSEC356 (T): Industrial applications in chemistry	2(T)	2	1.5	25	25	50

B. Sc. SEMESTER – V
CHM351(T): Organic Chemistry

Credit – 4, Hours – 60, Marks - 100

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline specific Courses – Core(Major)	CHM351(T): Organic Chemistry	4(T)	4	2.5	50	50	100

Course Outcomes:

After the completion of this course, student will be able to-
CO1: Know about advanced topics of organic chemistry.
CO2: Understand the advanced topics of stereochemistry, organic reactions, reagents and some natural products.
CO3: Apply the knowledge of stereochemistry, organic reactions, reagents and some natural products in structure determination, designing a synthesis, reaction mechanism etc.
CO4: Develop problem solving skill related to advance organic chemistry topics and environmental safety.

CO-PSO mapping (connecting COs with PSOs)
The mapping is a matrix with rows and columns as PSOs
Each element/cell of the matrix has a value in {--, 1,2,3}
The meaning associated with the values are as follows:
-- this CO (row) has nil/insignificant contribution to the PSO (column)
1 Relevant and small significant
2 Medium and moderate significant
3 Strong and high level of significant
These values have to be justified in the T-L-A of the course, particularly in terms of the BLOOM level of the question/problems

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	1	1	2	2
CO2	2	2	1	1	1	2
CO3	2	1		1	1	2
CO4	2	1		1	1	2

Unit – I: Stereochemistry **[25 Marks]**
[15 Hours]

(A) Stereoselective and stereospecific reactions. Mechanism of "Addition of halogens to alkenes". Stereochemistry of E2 reaction (syn and anti elimination).

(B) Concept of Prochirality: Homotopicity, enantiotopicity, dastereotopicity, prochiral centres, nomenclature PRO-R and PRO-S designations to enantiotopic and distereotopic groups, Re and Si designations to enantiotopic and distereotopic faces, Cram's and Prelog's rule, chiral synthesis, resolution technics.

Unit – II: (A) Inorganic reagents for Organic synthesis **[13 Marks]**
[8 Hours]

Use of specific reagents and their synthetic applications with mechanism. (i) Aluminium Isopropoxide (ii) Lithium Aluminium Hydride (iii) Adams's catalyst (PtO_2) (iv) Selenium Dioxide (v) Osmium Tetroxide (vi) Lead Tetraacetate.

(B) Molecular rearrangements and Name Reactions **[12 Marks]**
[7 Hours]

Rearrangements occurring through Carbocations, carbenes and nitrenes. Principle, Mechanism and Synthetic applications of the reactions: (i) Wolf rearrangement (ii) Fries migration (iii) Hoffmann reaction (iv) Oppenauer oxidation reaction (v) Diels-Alder reaction (vi) Birch Reduction.

Unit – III: (A) Nucleophilic Substitution at a Saturated Carbon Atom
[13 Marks]
[8 Hours]

Mechanism and scope of reaction-available mechanism, Kinetic Characteristics, Scope of reaction, Stereochemistry of SN1 and SN2 reactions, Relative reactivity in substitution, Solvent effect, variation at carbon site, Relative leaving group activity, SNi (substitution nucleophilic internal) Mechanism and Neighboring group participation. Elimination Reactions, E1, E2 and E1cB mechanism, Orientation E1and E2 reactions, Elimination Vs Substitution.

(B) Nucleophilic aromatic substitution **[12 Marks]**
[7 Hours]

Bimolecular displacement and its mechanism, Reactivity, Orientation, Electron withdrawal by resonance, Evidence for the two steps-mechanism, Elimination-addition mechanism- Benzyne.

Unit – IV: (A) Alkaloids **[13 Marks]**
[8 Hours]

Classification, General method of determining structure, analytical and synthetic methods, structure of Coniine, Nicotine, Atropine and Papaverine.

(B) Isoprenoids **[12 Marks]**
[7 Hours]

Classification, General method of determining structure, Isoprene rule, Chemistry of Citral, α-Terpineol, Camphor and their synthesis, study of reactions of β-carotene (No Synthesis)

Reference Books

(1) Organic Chemistry: I. L. Finar, Vol-II, 5th Edition, Pearson Education Ltd.
(2) Organic Chemistry: Morrison & Boyd, 6th Edition, Prentice Hall of India Pvt. Ltd.
(3) Stereochemistry of carbon compounds: E. L. Eliel, Wiley Eastern Ltd.
(4) Stereochemistry and mechanism through solved problems: P. S. Kalsi, New Age International.
(5) Stereochemistry of Organic Compounds: Principles and Applications: D. Nasipuri; New Academic Science; 4th Revised Edition.
(6) Organic Chemistry: Hendrickson, Cram, Hammond, Mc Graw-Hill.
(7) Organic Chemistry: 6 th Edition, John Mcmurry, Brooks Cole, International Edition.
(8) Organic Chemistry: T.W. Graham Solomons and Craig B. Fryhle Wiley, 8 th Edition.
(9) Organic Chemistry: Francis A. Carey, Mc Graw-Hill, 7 th Edition.
(10) Organic Chemistry: Leroy G.Wade, Prentice Hall, 6 th Edition.
(11) Organic Chemistry: Jonathan Clayden, Nick Greeves, Stuart Warren and Peter Wothers. Oxford University Press, USA.

B. Sc. SEMESTER – V
CHM352(T): Analytical Spectroscopic Techniques

Credit – 4, Hours – 60, Marks - 100

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline specific Courses – Core(Major)	CHM352(T): Analytical Spectroscopic Techniques	4(T)	4	2.5	50	50	100

Course Outcomes:

After the completion of this course, student will be able to-
CO1: Know about UV, IR, NMR, Mass and Atomic spectroscopy.
CO2: Understand the principle, theory and applications of UV, IR, NMR, Mass and Atomic spectroscopy.
CO3: Apply the knowledge to solve problems related to UV, IR, NMR and mass spectroscopy.
CO4: Create ability to interpret spectra related to UV, IR, NMR, mass and Atomic spectroscopy for structure determination and elemental analysis which can be helpful to analyse research problems.

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	1	2	1
CO2	2	2	1	1	1	1
CO3	2	1	1	1	1	1
CO4	2	1	1	1	1	1

UNIT I Ultraviolet Spectroscopy [15 Hours]

(A) Ultraviolet Spectroscopy [13 Marks]

Origin of UV Spectra, Principle, Electronic transition (σ-σ*, n-σ*, π-π* and n-π*),Chromophore concept,Auxochrome, relative positions of λmax considering conjugative effect, steric effect, solvent effect, red shift (bathochromic shift), blue shift (hypochromic shift), hyperchromic effect, hypochromic effect (typical examples). Aromatic and Polynuclear aromatic hydrocarbons.

(B) Ultraviolet Spectroscopy (Problems) [12 Marks]

Problems of Dienes and enones using Woodward-Fieser rules. Problems of aromatic ketones, aldehydes and esters (Benzoyl system) using empirical rules.

UNIT II Infrared and Mass Spectroscopy [15 Hours]

(A) Infrared Spectroscopy [13 Marks]

Introduction, principle of IR spectroscopy, instrumentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies, applications. Application of Hooke's law, characteristic stretching frequencies of O-H, N-H, C-H, C-D, C=C, C=N, C=O functions; factors affecting stretching frequencies (H-bonding, mass effect, electronic factors, bond multiplicity, ring size).

(B) Mass spectrometry: [12 Marks]

Mass spectrometry: theory, instrumentation, modes of ionization, types of detectors, modes of fragmentation. Different types of ions, molecular ions, isotopic peaks, factors controlling fragmentation, hyphenated mass spectroscopy techniques.

UNIT III ^{1}H Nuclear Magnetic Resonance [15 Hours]

(A) ^{1}H Nuclear Magnetic Resonance [13 Marks]

Principal, Magnetic and nonmagnetic nuclei, absorption of radio frequency. Equivalent and non-equivalent protons, chemical shifts, anisotropic effect, relative strength of signals, spin-spin coupling, long range coupling, coupling constant, Deuterium labelling, applications to simple structural problems.

(B) Problems based on Spectral data Structural problems based on UV, IR and NMR [12 Marks]

UNIT IV Visible and Atomic Spectroscopy [15 Hours]

(A) Visible Spectroscopy [13 Marks]

Introduction, Beer Lambert's law, instrumentation (light source, optical system, wavelength selector, light sensitive device), Accuracy and error of Spectrophotometry.

(B) Atomic Spectroscopy [12 Marks]

Introduction, Principle, Flame Emission Spectroscopy (FES) and Atomic adsorption Spectroscopy (AAS), Principle, comparison and applications, Burners

(Total consumption burner and Premix burners), inductively coupled plasma Emission Spectroscopy (ICPES)

Reference Books

1. Introduction to Spectroscopy: Donald L. Pavia, Gary M. Lampman, George S. KrizCengage Learning; 4th Edition.
2. Spectrometric Identification of Organic Compounds: Robert M. Silverstein, Francis X. Webster, David Kiemle Wiley; 7th Edition.
3. Infrared spectra of Complex molecules: J. Bellamy, John Wiley & Sons, Inc., 3rd Edition. Spectroscopic Method in Organic Chemistry: Dudley Williams, Ian Fleming McGrawHill Education; 6th Edition.
4. Applications of spectroscopic techniques in Organic Chemistry: P.S. Kalsi, New Age International; 6th Edition.
5. Elementary Organic Spectroscopy; Principles And Chemical Applications: Y. R. Sharma, S. Chand & Co Pvt Ltd.
6. Fundamentals of Molecular Spectroscopy: C. M. Banwell and E. McCash, Tata McGraw Hill, 4th Edition.

B. Sc. SEMESTER – V
CHM353(P) – Chemistry Practical
Chemistry Lab – I (2 credit) + Chemistry Lab- II (2 credit)
Total Credit – 4, Hours – 120, Marks = 100

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline specific Courses – Core (Major)	CHM353(P): Chemistry Practical	4(P)	8	6.0	50	50	100

Course Outcomes:

After the completion of this course, student will be able to-

CO-1. Gain the fundamental and basic knowledge of inorganic qualitative analysis, chemical kinetics and Physico-chemical experiments.
CO-2. Understand the basic concepts and principles of cations and anions of inorganic salts, conductometer, pH-meter, potentiometer and colorimeter.
CO-3. Apply the skill of separation of cations and anions present in an inorganic mixture and how to handle different instruments like conductometer, pH-meter, potentiometer and colorimeter.
CO-4. Analyse and conclude the facts regarding the inorganic qualitative analysis and chemical kinetics.
CO-5. Evaluate, judge and defend the different types of tests involves in the separation of inorganic radicals and different types titration using instruments.
CO-6. Synthesise, Create, modify and develop the new techniques for the separation of inorganic radicals and in the use of different instruments like conductometer, pH-meter, potentiometer and colorimeter.

CO-PSO mapping (connecting COs with PSOs)

CO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	3	2	3	2	2
CO-2	3	3	2	2	2	3
CO-3	2	3	3	2	3	2
CO-4	3	2	3	3	2	3
CO-5	3	2	3	2	2	3
CO-6	3	3	3	2	2	3

CHM353(P) – Chemistry Practical

CHEMISTRY LAB – I

Credit – 2, Hours – 60, Marks - 50

Inorganic qualitative analysis for inorganic Mixture
Semi micro method of analysis of inorganic mixture containing six radicals (Including phosphate, borate, arsenite, arsenate, antimony, tin)
A minimum 10 mixtures should be performed.

Viva-Voce questions

CHEMISTRY LAB – II

Credit – 2, Hours – 60, Marks - 50

PHYSICAL CHEMISTRY PRACTICAL

A minimum 11 practicals should be performed

(1) To Study Reaction between $K_2S_2O_8$ and KI (a = b).
(2) To Study Reaction between $KBrO_3$ and KI (a = b)
(3) To Study Reaction between $K_2S_2O_8$ and KI ($a \neq b$).
(4) To Study Reaction between $KBrO_3$ and KI ($a \neq b$)
(5) Determine the heat of solution of a given organic acid by solubility method.
(6) Determine concentration of xN NaOH and yN NH_4OH in the given mixture using 0.1N HCl by conductometrically.
(7) Determine concentration of xN $BaCl_2$ using 0.1N K_2CrO_4.
(8) To titrate the given solution of xN HCl against 0.1N NaOH pH metrically.
(9) Determine the dissociation constant of monobasic weak acid (acetic acid) using 0.1N NaOH pH metrically by half neutralization method.
(10) To titrate given $FeSO_4.7H_2O$ or $FeSO_4(NH_4)_2SO_4.6H_2O$ solution against 0.1N $KMnO_4$ potentiometrically.
(11) To titrate given xN HCl solution against 0.1N NaOH potentiometrically using quinhydrone electrode.
(12) To study Beer's law and determine the concentration of unknown solution of Cu^{+2} by colourimetry.
(13) To study Beer's law and determine the concentration of unknown solution of CrO_4^{-2} by colourimetry.

Viva-Voce questions

REFERENCE BOOKS

1. 'Vogel's Qualitative analysis' by G. Svehla, Pearson Education Ltd., Seventh Edition,2009
2.'Vogel's Textbook of Quantitative Chemical analysis' Revised by G. H. Jeffery, J. Bassett, J. Mendham & R. C. Denney, ELBS (English Language Book Society) Longman, 5th Ed., New York.
3. 'Analytical Chemistry' by Dhruba Charan Dash, 2011, 2th Ed., PHI Learning Private Ltd, New Delhi.
4. 'Advanced Practical Inorganic Chemistry' by Gurdeep Raj, 9th Ed., Goel Publishing House, Meerut.
5. 'Advanced University Practical Chemistry' by P. C. Kamboj, Vishal Publishing Co., Jallandhar – Delhi.
6. 'Advance Physical Practical Chemistry' by J. B. Yadav, Goel Publishing House, Meerut.
7. 'Advances Physical Chemistry Experiments' by Gurtu – Gurtu, Pragati Prakashan, Meerut.

B. Sc. SEMESTER – V
CHE354 (T) – Inorganic and Physico chemical science

Credit – 4, Hours – 60, Marks - 100

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline specific Courses – Minor	CHE354(T): Inorganic and Physico chemical science	4(T)	4	2.5	50	50	100

Course Outcomes:

After the completion of this course, student will be able to-

CO-1. Gain the fundamental knowledge of valence bond and molecular orbital theory, MO diagram of different types of molecules, hybridization and structure in carbonyls, adsorption and catalysis and physical properties.
CO-2. Understand the basic concepts of valence bond and molecular orbital theory**,** mixing of orbitals, back donation, multiple nature of M – CO bind, stricture of organometallic compounds, conductometric titrations and pollution control methods.
CO-3. Solve the problems regarding bond order, stability of the molecules, geometry of carbonyls, transport number, viscosity and refractive index.
CO-4. Analyse and correlate the facts regarding bonding in the molecules, role of terminal and bridging CO, factors affecting adsorption and different types of catalysis.
CO-5. Evaluate and criticize the principles of chemical bonding in compound and carbonyls, adsorption and catalysis reverse osmosis and electrodialysis.
CO-6. Create, modify and synthesise the facts of molecular orbital diagram of different molecules, preparation of carbonyls and organometallic compounds, application of catalysis and pollution control methods.

CO-PSO mapping (connecting COs with PSOs)

The mapping is a matrix with rows and columns as PSOs
Each element/cell of the matrix has a value in {--, 1,2,3}
The meaning associated with the values are as follows:
-- this CO (row) has nil/insignificant contribution to the PSO (column)
1 Relevant and small significant
2 Medium and moderate significant
3 Strong and high level of significant

These values have to be justified in the T-L-A of the course, particularly in terms of the BLOOM level of the question/problems

CO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	3	2	2	2	3
CO-2	3	3	2	2	2	3
CO-3	2	2	3	2	3	2
CO-4	3	2	3	3	2	3
CO-5	3	2	3	2	3	3
CO-6	3	3	2	2	3	3

Unit – I: Chemical Bonding **[25 Marks]**
[15 Hours]

Introduction, Valence bond theory of bond formation and its limitations (Heitler and London approach), Molecular orbital Theory, LCAO Method, conditions for the combination of atomic orbitals to form molecular orbitals, bonding and antibonding, σ and π molecular orbitals, mixing of orbitals and formation of molecular orbitals, energy level diagram for molecular orbitals, rules for filling up of electrons to molecular orbitals, Bond order and its calculation, relation between the stability of molecules and bond order, bond strength and bond energy, Molecular orbital diagrams of heteronuclear diatomic molecules (CO, NO, HF, HCl), Molecular orbital diagrams of heteronuclear polyatomic molecules (BeH_2, NH_3).

Unit – II: Metal carbonyls and Organometallic compounds
[25 Marks]
[15 Hours]

Introduction, Bonding between metal and carbon of CO (Multiple nature of M – CO bond), Back bonding, Mono and polynuclear metal carbonyls, structure of $Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$, $Mn_2(CO)_{10}$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$, $Co_2(CO)_8$, Application of IR spectra in the determination of structure of poly nuclear metal carbonyls.

Metal nitrosyls: Bonding in nitrosyl compound, structure of $Fe(CO)_2(NO)_2$, $Co(CO)_3NO$.

Metal carbonyl hydrides: Preparation and properties, structure of $Mn(CO)_5H$, $Fe(CO)_4H_2$.

Organometallic compounds: Introduction, classification, structure and application of organometallic compounds of Mg, Al.

Unit – III: (A) Adsorption and catalysis **[13 Marks]**
[8 Hours]

Adsorption and its terms, Factor affecting the adsorption of gases by solids, Factor affecting the adsorption of solids from solution, Types of adsorption, Adsorption isotherms, Freundlich adsorption isotherm, application of adsorption. Catalysis: Catalyst, types of catalysis, positive and negative catalysis, homogeneous and heterogeneous catalysis, properties of catalytic surface-active centers.

(B) Electro chemistry: **[12 Marks]**
[7 Hours]

Transference numbers, Determination of transport number, moving boundary method, result of transport number measurements, Conductometric titrations: (i) HCl → NaOH, (ii) CH_3COOH → NaOH, (iii) H_3BO_3 → NaOH (iv) HCl + CH_3COOH → NaOH, activity, activity co-efficient and ionic strength, numerical.

Unit – IV: (A) Physico chemical techniques in Pollution control
[13 Marks] [8 Hours]

Desalination and reverse osmosis, Electrodialysis, Electrochemistry and pollution control, Removal of Cu, Ag and Fe from waste water, numerical.

(B) Physical properties of liquid **[12 Marks]**
[7 Hours]

Physical properties of liquid such as surface tension, viscosity, Refractive index, optical property, numerical.

REFERENCE BOOKS

1. 'Concise Inorganic Chemistry' by J. D. Lee, 5th Ed., 2013, Wiley India.
2. 'Inorganic Chemistry' by Shriver & Atkins, 5th Ed., 2013, Oxford University Press.
3. 'Modern Inorganic Chemistry' by Dr. R. D. Madan, 1987, S. Chand, New Delhi.
4. 'Basic Inorganic Chemistry' by F. A. Cotton, Geoffrey Wilkinson, Carlos A Murilloand Manfred Bochmann, 6th Ed., Wiley publication.
5. 'Principles of Inorganic Chemistry' by Puri, Sharma and Kalia, 2018, Vishal Publishing Co., Jallandhar – Delhi.
6. 'Physical Chemistry' by P. W. Atkins, 7/E, 2002, Indian Edition Oxford University Press.
7. 'Principle of Physical Chemistry' by Puri, Sharma & Pathania, 41/E, Vishal Publishers.
8. 'Essentials of Physical Chemistry' by Bahl & Tuli, 22/E, S. Chand publication, New Delhi.
9. 'Advanced Physical Chemistry' by Gurdeep Raj, 19/E, Goel Publishing House Meerut.

B. Sc. SEMESTER – V

CHE355(P) – Chemistry Practical

Chemistry Lab – I (2 credit) + Chemistry Lab- II (2 credit)

Total Credit – 4, Hours – 120, Marks = 100

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline specific Courses – (Minor)	CHE355(P): Chemistry Practical	4(P)	8	9.0	50	50	100

Course Outcomes:

After the completion of this course, student will be able to-

CO-1. Gain the fundamental and basic knowledge of inorganic qualitative and quantitative analysis.
CO-2. Understand the basic concepts and principles of cations and anions of inorganic salts, gravimetric and volumetric analysis.
CO-3. Apply the skill of separation of cations and anions present in an inorganic mixture and accuracy during the gravimetric and volumetric analysis.
CO-4. Analyse and conclude the facts regarding the inorganic qualitative analysis and quantitative analysis.
CO-5. Evaluate, judge and defend the different types of tests involves in the separation of inorganic radicals.
CO-6. Synthesise, Create, modify and develop the new techniques for the gravimetric and volumetric analysis.

CO-PSO mapping (connecting COs with PSOs)

CO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	3	2	3	2	2
CO-2	3	3	2	2	2	3
CO-3	2	3	3	2	3	2
CO-4	3	2	3	3	2	3
CO-5	3	2	3	2	2	3
CO-6	3	3	3	2	2	3

CHE355(P) – Chemistry Practical

CHEMISTRY LAB – I

Credit – 2, Hours – 60, Marks - 50

Inorganic salts (minimum requirement 06 salts)

K^+, NH_4^+, Na^+, Cu^{+2}, Cd^{+2}, Fe^{+2}, Fe^{+3}, Al^{+3}, Cr^{+3}, Mn^{+2}, Co^{+2}, Ni^{+2}, Zn^{+2}, Ca^{+2}, Ba^{+2}, Sr^{+2}, Mg^{+2} in the form of Cl^-, Br^-, I^-, NO_3^-, NO_2^{-1}, SO_4^{-2}, SO_3^{-2}, S^{-2}, PO_4^{-3}, CO_3^{-2}, CrO_4^{-2}, $Cr_2O_7^{-2}$, O^{-2}.

Inorganic qualitative analysis for inorganic Mixture
Semi micro method of analysis of inorganic mixture containing four radicals (Excluding phosphate, borate, arsenite, arsenate)
Minimum eight mixtures should be performed.

Exam: Inorganic mixture

Viva-Voce questions

CHEMISTRY LAB – II

Credit – 2, Hours – 60, Marks – 50

Analytical Chemistry Practical

Gravimetric Analysis:
(1) Determine the amount of iron (Fe^{+2}) as Fe_2O_3 gravimetrically in the given solution of $FeSO_4(NH_4)_2SO_4 . 6H_2O$ or $FeSO_4 . 7H_2O$ and free H_2SO_4.
(2) Determine the amount of Aluminium (Al^{+3}) as Al_2O_3 gravimetrically in the given solution of $Al(SO_4)_3 . 18H_2O$ and free H_2SO_4.
(3) Determine the amount of Barium (Ba^{+2}) as $BaSO_4$ gravimetrically in the given solution of $BaCl_2 . 2H_2O$ and free HCl.
(4) Determine the amount of Nickel (Ni^{+2}) as Ni – (DMG) gravimetrically in the given solution of $NiCl_2 . 2H_2O$ and free HCl.

Volumetric Analysis:
(1) Determine the amount of Nitrite (NO_2^{-1}) in the given solution of KNO_2 or $NaNO_2$ by back titration using $KMnO_4$ and $FeSO_4(NH_4)_2SO_4 . 6H_2O$ solution.
(2) Determine the amount of Nickel (Ni^{+2}) in the given solution of $NiCl_2.2H_2O$ by back titration using EDTA solution.

(3) Determine the hardness of water in ppm in the given solution containing Ca^{+2} and Mg^{+2} ions.
(4) Determination of available Cl_2 in bleaching powder.
(5) Determine the amount of Acetamide in the given solution.
(6) Determine the amount of Glucose in the given solution.

Viva-Voce questions

REFERENCE BOOKS

1. 'Vogel's Qualitative analysis' by G. Svehla, Pearson Education Ltd., Seventh Edition,2009
2.'Vogel's Textbook of Quantitative Chemical analysis' Revised by G. H. Jeffery, J. Bassett, J. Mendham & R. C. Denney, ELBS (English Language Book Society) Longman. 5th Ed., New York.
3. 'Analytical Chemistry' by Dhruba Charan Dash, 2011, 2th Ed., PHI Learning Private Ltd, New Delhi.
4.'Analytical Chemistry' by Gary D. Christian, 1986, 4th Ed., John Wiley & Sons.
5. 'Analytical Chemistry: Practice' by John H. Kennedy, Saunders College Publishing, New York, Second Edition, 1990.
6. 'Quantitative Analysis' by R. A. Day, A. L. Underwood, Prentice-Hall of India Pvt.Ltd., New Delhi, Sixth Edition, 2004.
7. 'Advanced Practical Inorganic Chemistry' by Gurdeep Raj, 9th Ed., Goel Publishing House, Meerut.
8. 'Advanced University Practical Chemistry' by P. C. Kamboj, Vishal Publishing Co., Jallandhar – Delhi.

B. Sc. SEMESTER – V
SKILL ENHANCEMENT COURSE
CHSEC356(T) - Industrial applications in chemistry
Credit – 2, Theory Hours – 30

Course outcomes:

After the completion of this course, student will be able to-

CO1: Know about industrial products such as drugs, dyes and complexing agents
CO2: Understand the preparations and uses of drugs, dyes and complexes.
CO3: Develop problem solving skill related to industrial and analytical technics.
CO4. Gain the skill to establish green and easy methods to prepare different drugs and dyes.
CO5. Create, modify and synthesise preparation and application of drugs, dyes and complexing agents.
CO6. Gain the skill regarding modification in drug designing.

CO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	3	2	3	2	3
CO-2	3	3	2	3	2	3
CO-3	2	3	3	2	3	2
CO-4	3	2	3	2	2	3
CO-5	3	2	3	2	3	3
CO-6	3	2	3	2	3	3

UNIT I DYES AND DRUGS **[25 marks] [15 Hours]**

(A) Synthetic Dyes **[12 Marks]**

Classification of Dyes- Anionic and Cationic dyes, Mordant and Vat dyes, Reactive and Dispersed dyes, Synthesis of Malachite green, Indigo, H-acid, (J-acid & K-acid, only structures), reactive Yellow (MERL yellow 145), reactive red (ME4BL Red 195), Reactive black (Black 5 RAMAZOL), chemical index of dyes

(B) Synthetic Drugs **[13 Marks]**

General Classification, Based on Analgesics,Antipyretics, Hypnotics, Sedatives, Anaesthetics, Antimalerials, Antiseptics, Antibacterial: Suplha drugs & Antibiotics, Cardiovascular drugs, Antidiabetic. (Minimum one illustration of each, with name and structure). Methods of preparation and uses of Paracetamol, Antipyrine, Cycloserine, Alprazolam, Zaleplon, Lidocaine, Chloroquine, Atenolol, Sulphadiazine, Trimethoprim and Tolbutamide.

UNIT 2 COMPLEXOMETRY TITRATIONS [25 marks] [15 hours]

Introduction, Requirements for complexometry titrations, EDTA as a complexing agents, Effect on EDTA titrations: pH effect, Ligand Effect, Hydrolysis effect, metallochrome indicators: EBT, Pyrrocatachol violet, Muroxide, Types of titrations: Direct titrations, Back titrations, Replacement titrations, Alkalimetry titrations, Masking, Demasking agents

Reference Books

(1) Burger's medicinal chemistry and drug design (5/e) 1997, vol 1 to 5 edited by Manfred E.Woltt (John wiley and sons Mc. New york)
(2) Principles of medicinal chemistry by William A. Foye (ied), lea and febiys(Philadelphia)
(3). Medicinal chemistry by ashutosh kar
(4) Analytical Chemistry: Gary D. Christian, 6th Edition; Wiley & Sons
(5) Fundamentals of Analytical Chemistry: D. A. Skoog, D. M. West and F. J. Holler, 9th Edition, Cengage Learning.
(6) Quantitative Chemical Analysis: Daniel C. Harris, W H Freeman, New York.

B. Sc. SEMESTER VI
CHEMISTRY
EFFECTIVE FROM – JUNE 2026
ACCORDING TO NEP - 2020
Course Structure with respect to credit, hours and marks for Sem - VI

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline specific Courses – Core (Major)	CHM361(T): Inorganic Chemistry	4(T)	4	2.5	50	50	100
	CHM362(T): Physical Chemistry	4(T)	4	2.5	50	50	100
	CHM363(P): Chemistry Practical	4(P)	8	9.0	50	50	100
Discipline Specific Courses – Minor	CHE364(T+P): Organoanlytical chemistry	2(T)	2	1.5	25	25	50
		2(P)	4	3.0	25	25	50
Internship		4					

B. Sc. SEMESTER – VI
CHM361(T): Inorganic Chemistry

Credit – 4, Hours – 60, Marks - 100

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline specific Courses – Core(Major)	CHM361(T): Inorganic Chemistry	4(T)	4	2.5	50	50	100

Course Outcomes:

After the completion of this course, student will be able to-

CO-1. Gain the fundamental knowledge of molecular symmetry, symmetry elements and symmetry operations, trans effect, different theory of trans effect, Hermitian operator, particle in three dimensional box, rigid rotator, term symbol and electronic spectra of complex compounds.
CO-2. Understand the basic concepts of group property and point group**,** inorganic reaction mechanisms involved in complexes, wave function and energy equation for particle in three dimensional box and ring, Schrodinger equation in spherical polar coordinates, determination of term symbol and microstates.
CO-3. Solve the problems regarding point group, group multiplication table, application of trans effect, particle in three dimensional box and ring, normalised wave function, Hermitian operator, determination of term symbol in ground state and electronic spectra of the complex compounds.
CO-4. Analyse and correlate the facts regarding visualisation of symmetry elements symmetry operations, geometry of compounds, mechanism involved during substitution reactions in complexes, Hermitian property, Pigeon hole diagram of p^2 and d^2 configuration, Hole formulation and Orgel energy level diagram.
CO-5. Evaluate and criticize the principles of molecular symmetry, substitution reaction of complexes, solution of Schrodinger equation in spherical polar coordinates, term symbol and Laporte orbital and spin selection rules.
CO-6. Create, modify and synthesise the facts of point group of molecules, Factors affecting the rates of substitution reaction in square planar complexes, wave function and energy equation for particle in three dimensional box and ring, term symbol, microstates and Orgel energy level diagram.

CO-PSO mapping (connecting COs with PSOs)

The mapping is a matrix with rows and columns as PSOs
Each element/cell of the matrix has a value in {--, 1,2,3}
The meaning associated with the values are as follows:
-- this CO (row) has nil/insignificant contribution to the PSO (column)
1 Relevant and small significant
2 Medium and moderate significant
3 Strong and high level of significant
These values have to be justified in the T-L-A of the course, particularly in terms of the BLOOM level of the question/problems

CO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	3	2	2	2	3
CO-2	3	3	2	2	2	3
CO-3	2	2	3	2	3	2
CO-4	3	2	3	3	2	3
CO-5	3	2	3	2	3	3
CO-6	3	3	2	2	3	3

Unit – I: Molecular Symmetry **[25 Marks]**
[15 Hours]

Introduction, symmetry elements and symmetry operations, identity (E), proper axis of rotation (C_n), plane of symmetry (σ) and its types, centre of inversion (i), improper axis of rotation (S_n), effect of symmetry operations on different molecules, point groups of the molecules (excluding S_{2n} and I_h), group multiplication tables of C_{2v}, C_{2h} and C_{3v} point groups.

Unit – II: Inorganic Reaction Mechanisms and Trans effect
[25 Marks]
[15 Hours]

Labile and inert complexes, lability, inertness, stability and instability, ligand field effects and reaction rates, mechanism of nucleophilic (ligand) substitution reactions (SN^1 and SN^2) in octahedral complexes, anation reactions, substitution reactions without breaking metal – ligand bond, hydrolysis reactions (Acid and base hydrolysis reactions), SN^1_{CB} mechanism.

Trans effect, applications of trans effect in synthesis and analysis, synthesis of cis and trans – $[PtCl_2(NO_2)(NH_3)]$ complexes, synthesis of cis and trans – $[Pt(C_2H_4)(NH_3)Cl_2]$ complexes, synthesis of $[Pt(py)(NH_3)BrCl]$, theories of trans effect: Polarisation theory, π- bonding theory, MO theory, mechanism of substitution reactions in square planar complexes, factors affecting the rates of substitution

reaction in square planar complexes, electron transfer or redox reactions (inner-sphere and outer-sphere reactions and mechanisms), cis effect.

Unit – III: Quantum chemistry **[25 Marks]**
[15 Hours]

Hermitian property of operators, properties of Hermitian operator, rules for setting up of quantum mechanical operators, linear momentum operator, Hamiltonian operator, angular momentum operator, particle in a three dimensional box (Separation of variables, normalized wave function, energy equation, zero-point energy, degeneracy), particle in a circular ring, qualitative treatment of Hydrogen and hydrogen-like ions, setting up of Schrodinger equation in spherical polar coordinates, Separation of variables, solution of ϕ-equation, solution of the legendre equation, solution of radial equation, Rigid rotator model of rotational of diatomic molecule (energy equation, Schrodinger wave equation for the rigid rotator in spherical polar coordinates θ and ϕ).

Unit – IV: Term symbol and Electronic spectra of metal complexes
[25 Marks]
[15 Hours]

Term symbol, representation of term symbol, Russel Saunders coupling and determination of term symbols of the ground state, total spin angular momentum quantum number (S), spin multiplicity, total orbital angular momentum quantum number (L), total angular quantum number (J), calculation of number of microstates, Pigeon hole diagram of p^2 and d^2 configuration, Hund's rule, Hole formulation.

Electronic spectra of transition metal complexes, Laporte orbital and spin selection rules, Orgel energy level diagram of d^5 and combined diagrams of d^1 - d^9, d^2 – d^8, d^3 – d^7, d^4 – d^6 and their spectra, Jahn Teller distortion, Spectrochemical series.

REFERENCE BOOKS

1. 'Concise Inorganic Chemistry' by J. D. Lee, 5th Ed., 2013, Wiley India.
2. 'Basic Inorganic Chemistry' by F. A. Cotton, Geoffrey Wilkinson, Carlos A Murilloand Manfred Bochmann, 6th Ed., Wiley publication.
3. 'Symmetry and group theory in chemistry by R Ameta, New Age International Publication Limited, New Delhi.
4. 'Inorganic Chemistry' by Shriver & Atkins, 5th Ed., 2013, Oxford University Press.

5. ‘Modern Inorganic Chemistry’ by Dr. R. D. Madan, 1987, S. Chand, New Delhi.
6. ‘Principles of Inorganic Chemistry’ by Puri, Sharma and Kalia, 2018, Vishal Publishing Co., Jallandhar – Delhi.
7. ‘Introductory Quantum Chemistry’ by A. K. Chandra, 4th Ed., 2017, Tata Mc Graw Hill PublishingCompany Limited, New Delhi.
8.‘Quantum chemistry’ by R. K. Prasad, 2nd Ed.,1996, New Age International publishers.
9. ‘Elements of Quantum Mechanics’ by Michael D. Fayer, Indian Ed., 2001, Oxford University Press.

B. Sc. SEMESTER – VI
CHM362(T): Physical Chemistry

Credit – 4, Hours – 60, Marks - 100

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline specific Courses – Core(Major)	CHM362(T): Physical Chemistry	4(T)	4	2.5	50	50	100

Course Outcomes:

After the completion of this course, student will be able to-
CO1: Know about advanced topics of physical chemistry
CO2: Understand the principle and theory of different laws of thermodynemics, electrochemistry, solid and liquid states, phase rule and photochemistry
CO3: Apply the knowledge to predict the feasibility of reaction, emf calculations, arrangement of constituent particles in solid, phase transition conditions and photochemical technique.
CO4: Create problem solving skills related to advanced topics of physical chemistry for environmental safety and research.

CO-PSO mapping (connecting COs with PSOs)

The mapping is a matrix with rows and columns as PSOs
Each element/cell of the matrix has a value in {--, 1,2,3}
The meaning associated with the values are as follows:
-- this CO (row) has nil/insignificant contribution to the PSO (column)
1 Relevant and small significant
2 Medium and moderate significant
3 Strong and high level of significant
These values have to be justified in the T-L-A of the course, particularly in terms of the BLOOM level of the question/problems

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	3	2	2	3
CO2	2	2	3	2	1	3
CO3	1	1	2	1	1	2
CO4	2	2	2	1	1	2

UNIT: I Thermodynamics [25 marks]
[15 Hours]

Zeroth law of Thermodynamics, Difference between Heat and temperature, Thermometric equation, Clausius - Clapeyron equation, Application of Clausius - Clapeyron equation, Trouton's Rule, Craft's equation, Colligative properties , Elevation of Boiling point, Depression of freezing point, Third law of thermodynamics. Numerical.

UNIT II Electrochemistry [25 marks]
[15 Hours]

Electrochemical cell and Electrolytic cell, Reversible and irreversible electrodes and cell, Poggendorff's compensation method and Weston cell, Reference electrodes (i) Saturated Calomel Electrode (ii) Standard Hydrogen Electrode (iii) Quinhydrone Electrode, Nernst's single electrode potential equation, Concentration cell and their classification, cell with and without transference. Applications of emf measurements to calculate ΔG^o , ΔH, ΔS , K_{eq}, K_{sp}, K_w and K_h.

UNIT III Solid state and liquid state [25 marks]
[15 Hours]

(A) Solid State Solid State

Unit Cells, Miller indices, crystal systems and Bravais Lattices, elementary applications of vectors to crystal systems; X-ray diffraction, Bragg's Law, Structure of NaCl, CsCl, and KCl, diamond, and graphite; Close packing in metals and metal compounds.

(B) Liquid State Liquid State: Physical properties of Liquid, vapour pressure, surface tension and viscosity, Refractive index, optical property and numericals.

UNIT IV Phase rule and Photochemistry [25 marks]
[15 Hours]

(A) Phase Rule

Phase rule and it terms, theoretical derivation of phase rule, One component system (water system and sulphur system), condensed phase rule (Ag-Pb and Zn-Cd system), Zeotropic and Azeotropic mixture, steam distillation, Zone refining. Example

(B) Photochemistry

Laws of Photochemistry: Grotthuss-Draper Law, Einstein Law, Quantum yield, Reasons for high and low quantum yield, Fluorescence and Phosphorescence, Chemiluminescence, Photosensitized reactions. Example

Reference Books

1. Physical Chemistry: G. M. Barrow, 5th Edition, McGraw-Hill education, India.
2. Advanced Physical Chemistry: Gurdeep Raj, 35th Edition (2009), Goel / Krshina Publishing House.
3. Principles of Physical Chemistry: Puri, Sharma and Pathania, 42nd Edition, Vishal Publishing Company.
4. Polymer Science: Gowariker, Viswanathan and Sreedhar, 1st Edition (2012 reprint) New Age International.
5. Essentials of Nuclear Chemistry: Arnikar, 4th Edition (2012 reprint), New Age International.
6. Physical Chemistry: Atkins, 9th Edition. Oxford University Press.
7. Advanced Physical chemistry: Gurtu and Gurtu, 11th Edition , Pragati Prakashan.
8. Physical chemistry: Levine, 6 th Edition, McGraw-Hill education, India.

B. Sc. SEMESTER – VI
CHM363(P) – Chemistry Practical

Chemistry Lab – I (2 credit) + Chemistry Lab- II (2 credit)
Total Credit – 4, Hours – 120, Marks = 100

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline specific Courses – Core (Major)	CHM363(P): Chemistry Practical	4(P)	8	9.0	50	50	100

Course Outcomes:

After the completion of this course, student will be able to-
CO-1. Gain the fundamental and basic knowledge of types of separation techniques, organic preparations and inorganic quantitative analysis.
CO-2. Understand the basic principle and applications of separation techniques, organic preparations, gravimetric and volumetric analysis.
CO-3. Apply the knowledge to solve problems related to identification, synthesis and purification.
CO-4. Analyse and conclude the facts regarding the organic qualitative analysis and inorganic quantitative analysis.
CO-5. Evaluate, judge and defend the different types of tests involves in the organic spotting.
CO-6. Develop problem solving skills for organic synthesis, separation and indetification, impurity profile and purity which can be helpful to analyse research problems

CO-PSO mapping (connecting COs with PSOs)

CO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	3	2	3	2	2
CO-2	3	3	2	2	2	3
CO-3	2	3	3	2	3	2
CO-4	3	2	3	3	2	3
CO-5	3	2	3	2	2	3
CO-6	3	3	3	2	2	3

CHEMISTRY LAB – I

Credit – 2, Hours – 60, Marks - 50

Organic practical

A Separation and identification of binary organic mixture **8 mixtures** (solid+solid, solid+liquid and liquid+liquid)

B Organic preparations (Chemical Reaction, mechanism, calculation for % practical yield, and crystallization)

1. Benzilic acid from benzil
2. Dibenzal acetone from benzaldehyde

C Thin layer Chromatography

1. TLC of paracetamol
2. TLC of Aspirin

Viva-Voce questions

CHEMISTRY LAB – II

Credit – 2, Hours – 60, Marks - 50

Gravimetric Analysis:

(1) Determine the amount of iron (Fe^{+2}) as Fe_2O_3 in the given solution of $FeSO_4(NH_4)_2SO_4.6H_2O$, $CuSO_4.5\ H_2O$ and free H_2SO_4 by gravimetrically.
(2) Determine the amount of Aluminium (Al^{+3}) as Al_2O_3 in the given solution of $Al(SO_4)_3.18H_2O$, $CuSO_4.5H_2O$ and free H_2SO_4 by gravimetrically.
(3) Determine the amount of Barium (Ba^{+2}) as $BaSO_4$ gravimetrically in the given solution of $BaCl_2.2H_2O$, $FeCl_3.\ 6H_2O$ and free HCl by gravimetrically.
(4) To find the % of Zn gravimetrically as $Mn_2P_2O_7$ and Cu volumetrically in the given brass alloy sample.
(5) To find the % of Ni gravimetrically as Ni- $(DMG)_2$ and Cu volumetrically in the given German silver alloy sample.

Volumetric Analysis:

(1) To determine the amount of Bi^{+3} in the given solution of $Bi(NO_3)_3.\ 5H_2O$ by volumetrically.
(2) To determine the amount of Fe^{+3} in the given solution of $FeCl_3.6H_2O$ by EDTA (Back titration)

(3) To determine Ca^{+2} and Mg^{+2} from a given mixture of $CaCl_2.2H_2O$ and $MgCl_2.2H_2O$ using EDTA solution.
(4) To determine the amount of Cl^{-1} (Chloride) from the given solution of NaCl.
(5) Estimation of unknown acid.
(6) Estimation of ketone.

Viva-Voce questions

REFERENCE BOOKS

1. Elementary Practical Organic Chemistry: Qualitative Organic Analysis: I. 2nd addition I. Vogel 2010
2. Small scale preparations: A. I. Vogel
3. Practical organic Chemistry: Mann and Saunders 4th edition.
4. Comprehensive Practical Organic Chemistry Preparation And Quantitative Analysis Universities press (India) Pvt ltd.
5. 'Analytical Chemistry: Practice' by John H. Kennedy, Saunders College Publishing, New York, Second Edition, 1990.
6. 'Quantitative Analysis' by R. A. Day, A. L. Underwood, Prentice-Hall of India Pvt.Ltd., New Delhi, Sixth Edition, 2004.
7. 'Analytical Chemistry' by Gary D. Christian, , John Wiely & Sons, INC, New York, Fifth Edition, 1994.
8. 'Vogel's Qualitative analysis' by G. Svehla, Pearson Education Ltd., Seventh Edition,2009
9. 'Vogel's Textbook of Quantitative Chemical analysis' Revised by G. H. Jeffery, J. Bassett, J. Mendham & R. C. Denney, ELBS (English Language Book Society) Longman. 5th Ed., New York.

B. Sc. SEMESTER – VI
CHE364(T+P) – Organoanlytical chemistry

Credit – (2T+2P), Theory Hours – 30, Practical Hours – 60

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Marks
					Internal	External	
Discipline specific Courses – Minor	CHE364(T): Organoanlytical chemistry	2	2	1.5	25	25	50
	CHE364(P): Chemistry practical	2	4	3	25	25	50

Course Outcomes:
After the completion of this course, student will be able to-

CO1: Know about natural bio-polymer and complexing agents
CO2: Understand about natural bio-polymer and complexing agents
CO3: Apply the knowledge to solve environmental issues
CO3: Develop problem solving skill related to industrial and analytical technics.

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	1	1	2	2
CO2	2	2		1	2	2
CO3	2	2			2	1
CO4	2	2	1	2		2

UNIT 1 Nucleic acid **[25 Marks]**
[15 Hours]

Synthesis of purine, adenine, guanine, cytosine, pyrimidine, thiamine and uracil, Basic introduction to Nucleoside and nucleotide and nucleic acid

UNIT 2 **Complexometric titrations** **[25 Marks]**
[15 Hours]

Introduction, EDTA as complexing agent, Structure of M-EDTA complex, Requirements for EDTA titrations, Effect of pH in EDTA titrations,

Metallochrome indicators (EBT), Estimation of Ca-Mg by complexometric titrations using EDTA

Reference Books

1. 'Organic Chemistry' I L Finar, 6th Ed, 2022, Pearson.
2. 'Organic Chemistry' Morrison, R.T. and Boyd, R.N. 6th Ed. 1992, Prentice
3. Hall International, Inc., London. Analytical Chemistry: Gary D. Christian, 6th Edition; Wiley & Sons
4. Fundamentals of Analytical Chemistry: D. A. Skoog, D. M. West and F. J. Holler, 9th Edition, Cengage Learning.
5. Quantitative Chemical Analysis: Daniel C. Harris, W H Freeman, New York

CHE364 (P) – Chemistry Practical

CHEMISTRY LAB

Credit – 2, Hours – 60, Marks - 50

PHYSICAL CHEMISTRY PRACTICAL

Course Outcomes:

After the completion of this course, student will be able to-

CO-1. Gain the fundamental and basic knowledge of physico-chemical experiments.
CO-2. Understand the basic concepts and principles of cconductometer, refractometer and viscometer.
CO-3. Apply the skill how to handle different instruments like conductometer, refractometer and viscometer.
CO-4. Analyse and conclude the facts regarding the chemical kinetics.
CO-5. Evaluate, judge and defend the different types of titration using instruments.
CO-6. Synthesise, Create, modify and develop the new techniques to perform titrations using different instruments.

CO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	3	2	2	2	3
CO-2	3	3	2	2	2	3
CO-3	2	2	3	2	3	2
CO-4	3	2	3	3	2	3
CO-5	3	2	3	2	3	3
CO-6	3	3	2	2	3	3

Minimum ten practicals should be performed

(1) To determine the velocity constant for the hydrolysis reaction between H_2SO_4 and methyl acetate.

(2) To determine the temperature coefficient and energy of activation by hydrolysis of methyl acetate catalysed by acid.

(3) To study the adsorption of an organic acid by animal charcoal
(Acetic acid/Oxalic acid).

(4) To determine water equivalent of thermos flask and heat of weak acid using strong acid and base.

(5) To determine cell constant of conductivity cell by using KCl solution.

(6) Conductometric titration of strong acid → strong base (HCl → NaOH)

(7) Conductometric titration of weak acid → strong base (CH_3COOH → NaOH)

(8) Determine the concentration of given xN NaCl conductometrically using 0.1N $AgNO_3$ solution.

(9) To determine specific refraction and molar refraction of liquid A, B and its mixture.

(10) To determine absolute viscosities of liquid A, B and its mixture.

(11) To determine the surface tensions of liquids by using stalagmometer.

Viva-Voce questions

Reference books

1.'Advanced University Practical Chemistry' by P. C. Kamboj, Vishal Publishing Co., Jallandhar – Delhi.

2.'Advance Physical Practical Chemistry' by J. B. Yadav, Goel Publishing House, Meerut.

3. 'Advances Physical Chemistry Experiments' by Gurtu – Gurtu, Pragati Prakashan, Meerut.