AC: 02.06.2025 ITEM NO: 22.3

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: T.Y.B.Sc (NEP 2020)
Subject: Chemistry

Choice Based Credit System (CBCS)
with effect from
Academic Year 2025-2026

Deccan Education Society's Kirti M. Doongursee College (Autonomous) Proposed Curriculum as per NEP 2020 Year of implementation- 2025-26 Name of the Department: Chemistry				
Semester	**Course Code**	**Course Title**	**Vertical**	**Credit**
V	25CHEMJ511	Physical Chemistry-I	Major	2
	25CHEMJ512	Inorganic Chemistry-II	Major	2
	25CHEMJ513	Organic Chemistry-III	Major	2
	25CHEMJ51P	Chemistry Major Practical	MJ P	2
	25CHEMJ514	Introduction to Indian Medicinal Chemistry	MJ IKS	2
	25CHEEL511	Dyes	ELT-1	2
	25CHEEL51P	Dyes Practical's	ELP-1	2
	25CHEEL512	Heavy & Fine Chemicals - I	ELT-2	4
	25CHEMN521	Chemistry Minor	Minor T	2
	25CHEMN52P	Chemistry Minor Practical's	Minor P	2
	25CHEVS54P	Analytical Chemistry Practical's	VSC	2
	25CHEFP611	Field Project	FP	2
VI	25CHEMJ611	Physical Chemistry-I	Major	2
	25CHEMJ612	Inorganic Chemistry-II	Major	2
	25CHEMJ613	Organic Chemistry-III	Major	2
	25CHEMJ614	Analytical Chemistry Paper IV	Major	2
	25CHEMJ61P	Chemistry Major Practical	MJ P	2
	25CHEEL611	Drugs	ELT-1	2
	25CHEEL61P	Drugs Practical	ELP-1	2
	25CHEEL612	Heavy & Fine Chemicals -II	ELT-2	4
	25CHEMN621	Chemistry Minor	Minor T	2
	25CHEMN62P	Chemistry Minor Practical's	Minor P	2
	25CHEOJT61	On Job Training	OJT	4

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 – V

Course Code	Course Title	Credits	Lectures /Week
25CHEMJ511	**Paper I PHYSICAL CHEMISTRY**	**2**	**2**

Course Outcomes: After successful completion of the course, the learner will be able to;
CO1: Define the basic concepts of spectroscopy, interaction of electromagnetic radiation with matter, nuclear chemistry, nuclear transmutation, Fission and Fusion Processes . Relate the use of various spectroscopic techniques.
CO2: Illustrate and compare Vibrational, Rotational and Raman spectroscopic techniques. Explain Nuclear reactions and nuclear transmutation.
CO3: Apply the knowledge of molecular spectroscopy and nuclear chemistry.
CO4: Analyze molecular spectra and nuclear radiation.

Unit	Topics	No of Lectures
I	**1.0 MOLECULAR SPECTROSCOPY** 1.1 Rotational Spectrum: Introduction to dipole moment, polarization of a bond, bond moment, molecular structure, Rotational spectrum of a diatomic molecule, rigid rotor, moment of inertia, energy levels, conditions for obtaining pure rotational spectrum, selection rule, nature of spectrum, determination of internuclear distance and isotopic shift. 1.2 Vibrational spectrum: Vibrational motion, degrees of freedom, modes of vibration, vibrational spectrum of a diatomic molecule, simple harmonic oscillator, energy levels, zero-point energy, conditions for obtaining vibrational spectrum, selection rule, nature of spectrum. 1.3 Vibrational-Rotational spectrum of diatomic molecule: energy levels, selection rule, nature of spectrum, P and R branch lines. Anharmonic oscillator - energy levels, selection rule, fundamental band, overtones. Application of vibrational-rotational spectrum in determination of force constant and its significance. Infrared spectra of simple molecules like H_2O and CO_2. 1.4 Raman Spectroscopy: Scattering of electromagnetic radiation, Rayleigh scattering, Raman scattering, nature of Raman spectrum, Stoke's lines, anti-Stoke's lines, Raman shift, quantum theory of Raman	**15**

	spectrum, comparative study of IR and Raman spectra, rule of mutual exclusion CO_2 molecule.	
II	**NUCLEAR CHEMISTRY** 2.1. Introduction: Basic terms-radioactive constants (decay constant, half-life and average life) and units of radioactivity 2.2 Detection and Measurement of Radioactivity: Types and characteristics of nuclear radiations, behaviors of ion pairs in electric field, detection and measurement of nuclear radiations using G. M. Counter and Scintillation Counter. 2.3 Application of use of radioisotopes as Tracers: chemical reaction mechanism, age determination - dating by C14. 2.4 Nuclear reactions: nuclear transmutation (one example for each projectile), artificial radioactivity, Q - value of nuclear reaction, threshold energy. 2.5 Fission Process: Fissile and fertile material, nuclear fission, chain reaction, factor controlling fission process. multiplication factor and critical size or mass of fissionable material, nuclear power reactor and breeder reactor. 2.6 Fusion Process: Thermonuclear reactions occurring on stellar bodies and earth.	**15**

References: Unit I and II

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota
3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition ,John Wiley & Sons, Inc [part 1]
4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer
6. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall .of India, Pvt.Ltd. New Delhi.
10. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
11. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.
12. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.

13. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan , New Age International (P) Ltd., Publishers, 2011.
14. Chemical Kinetics,K. Laidler, Pearson Education India, 1987.
15. Practical Physical Chemistry 3rd edition A.M.James and F.E. Prichard , Longman publication
16. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
17. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
18. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
19. Experimental Physical Chemistry By V.D.Athawale.
20. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A. Gulati, R Chand and Co.2011.

Course Code	Course Title	Credits	Lectures /Week
25CHEMJ512	**PAPER II INORGANIC CHEMISTRY**	**2**	**2**

Course Outcomes:

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

CO1:

- To remember the different types of symmetry element and symmetry operations.
- To remember the inner transition elements with their atomic numbers.

CO2:

- To understand symmetry operations with respect to symmetry elements in various chemical compounds.
- To understand the existence of f-block elements with their characteristics, the concept of lanthanide contraction, variable oxidation states magnetic and spectral properties.

CO3:

- To study various types of symmetry operations in the simple compounds like water ammonia etc. and find out the point group for that molecule.
- To apply various separation methods along with applications of lanthanides, application of catalysts in the Contact process.

CO4:

- To analyze the symmetry concept by applying the molecular orbital theory for various chemical compounds like water, ammonia etc.
- To analyse the sophisticated techniques for lanthanides, VSEPR theory for interhalogens.

Unit	Topics	No of Lectures
I	**1. Molecular Symmetry and Chemical Bonding** 1.1Molecular Symmetry	15

	1.1.1 Introduction and Importance of Symmetry in Chemistry. 1.1.2 Symmetry elements and Symmetry operations 1.1.3 Concept of a Point Group with illustrations using the following point groups :(i)C2v (ii) D2h (iii) C2v (iv) C3v (v)C2h and (vi)D3h **1.2 Molecular Orbital Theory for heteronuclear diatomic molecules and polyatomic species** 1.2.1 Comparison between homonuclear and heteronuclear diatomic molecules. 1.2.2. Heteronuclear diatomic molecules like CO, NO and HCl, appreciation of modified MO diagrams for CO. 1.2.3 Simple triatomic species: H3+andH3 (correlation between bond angle and Molecular orbitals).Term such as Walsh correlation diagram, Symmetry Adapted Linear Combinations (SALCs), Ligand Group orbitals (LGOs), transformation of atomic orbitals into appropriate symmetry types, expected to be discussed 1.2.4. Molecular shape to molecular orbital approach in AB2 molecules. Application of symmetry concepts for linear and angular species considering σ- bonding only. (Examples like : i) BeH2, ii) H2O).	
II	**2 Chemistry of Inner Transition Elements** **2.1 Introduction:** Position in periodic table and electronic configuration of lanthanides and actinides. **2.2 Chemistry of Lanthanides with reference to** (i) lanthanide contraction and its consequences(ii) Oxidation states (iii) Ability to form complexes (iv) Magnetic and spectral properties **2.3: Occurrence**, extraction and separation of lanthanides by (i) Ion Exchange method and (ii) Solvent extraction method (Principles and technique) **2.4** Applications of lanthanides	**15**

References:
Unit I & II

1. Per Jensen and Philip R. Bunker , Fundamentals of Molecular Symmetry , Series in Chemical Physics, Taylor & Francis Group
2. J. S. Ogden, Introduction to Molecular Symmetry, Oxford University Press
3. Derek W. Smith, Molecular orbital theory in inorganic chemistry Publisher: Cambridge University Press
4. C. J. Ballhausen, Carl Johan Ballhausen, Harry B. Gray Molecular Orbital Theory: An Introductory Lecture Note and Reprint Volume Frontiers in chemistry Publisher
5. W.A. Benjamin, 1965
6. Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi.
7. Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand &

Co Ltd
8. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
9. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
10. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
11. G. Singh, Chemistry of Lanthanides and Actinides, Discovery Publishing House
12. Simon Cotton, Lanthanide and Actinide Chemistry Publisher: Wiley-Blackwell
13. B. H. Mahan, University Chemistry, Narosa publishing.
14. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
15. J. D. Lee, Concise Inorganic Chemistry, 4thEdn., ELBS,
16. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
17. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
18. Gary Wulfsberg, Inorganic chemistry, Viva Books Pvt,.Ltd. (2002).
19. Richard Harwood, Chemistry, chapter 10 Industrial inorganic chemistry
20. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth

Course Code	**Course Title**	**Credits**	**Lectures /Week**
25CHEMJ513	**Paper III ORGANIC CHEMISTRY**	**2**	**2**

CO1: To study the basic definitions of terms related to organic reactions, organic stereochemistry,
CO2: Understand basic principles of organic reaction mechanisms and stereochemistry of organic molecules.
CO3: Apply fundamentals of Organic Reaction Mechanism to various reactions. To apply basics to know stereochemistry of chiral compounds.
CO4: Analyzing the stereochemical outcomes of various organic reaction mechanisms.

UNIT	**TOPICS**	No of Lectures
I	**Stereochemistry:** Writing 3D molecular structures: Fischer Projection, Newman and Sawhorse Projection formulae (of erythro, threo isomers of tartaric acid	15

	and 2,3 dichlorobutane) and their interconversions Isomerism: Stereo-isomerism, Geometrical isomerism in alkene and cycloalkanes: cis–trans and syn-anti isomerism E/Z notations with C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Molecular chirality and elements of symmetry: Mirror plane symmetry, inversion center, rotation -reflection (alternating) axis. Enantiomers, Molecules with two similar and dissimilar chiral-centres, Dia stereoisomers, meso structures, racemic mixture, R/S designations. Chirality of compounds without a stereo genic center: cumulenes and biphenyls.	
II	**Mechanism of Organic Reactions: (10L)** The basic terms & concepts: bond fission, reaction intermediates, electrophiles & nucleophiles, ligand, base, electrophilicity vs. acidity & nucleophilicity vs basicity. Neighbouring group participation in nucleophilic substitution reactions**:** participation of lone pair of electrons, kinetics and stereochemical outcome. Acyl nucleophilic substitution (Tetrahedral mechanism): Acid catalyzed esterification of carboxylic acids (AAC2) and base promoted hydrolysis of esters (BAC2). Pericyclic reactions: classification and nomenclature: Electro cyclic reactions (ring opening and ring closing), cycloaddition, sigma tropic Rearrangement. **Molecular Rearrangements and name reactions (05L)** Mechanism of following rearrangements with examples and stereochemistry wherever applicable: Pinacol-pinacolone, Beckmann, Favorskii rearrangements, Name Reactions: Michael addition, Wittig reactions.	**15**

REFERENCE:

Unit I and 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: London, 1994.
6. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.

Course Code	Course Title	Credits	Lectures /Week
25CHEMJ51P	**Chemistry Major Practical**	**2**	**4**

Course Outcomes: After successful completion of the course, the learner will be able to.

CO1: Understand the basic concept of molecular spectroscopy and chemical thermodynamics. To recall the chemical reactions of qualitative organic analysis of the compounds.

CO2: Illustrate and compare various types of spectroscopies. To understand Solubility Principles. To understand the. Determine chemical type of mixture.

CO3: Apply the knowledge of molecular spectroscopy and chemical thermodynamics. Apply principles of acid-base chemistry to distinguish and separate components based on their acidic, basic, or neutral properties. To apply theoretical knowledge to separate solid-solid mixture of organic compounds.

CO4: Analyze given sample using molecular spectroscopy and chemical thermodynamics techniques. Analyze and identify organic compounds after separation.

UNIT	TOPICS	No of Lectures
1	To estimate the amount of fluoride in a given sample spectroscopically.	
2	To determine potassium content of a given sample by flame photometry.	
3	To determine the amount of sulphate in a given water sample turbidimetrically.	
4	Determination of half life of a radioactive isotope and decay constant from the given data.	
5	To calculate the time required to reach a certain radioactive activity (in	

	millicuries, mCi).	
6	To prepare potassium diaquabis(oxalato) cuprate(II)	
7	To prepare bis acetylacetonato copper(II).	
8	To prepare ferrous ethylene diammonium sulphate.	
9	To determine the percentage purity of $CuSO_4.5H_2O$ iodometrically from the binary mixture and detection of cation and anion of the impurity salt.	
10	To determine the percentage purity of $NiSO_4.7H_2O$ complexometrically from the binary mixture and detection of cation and anion of the impurity salt.	
11	Separation of Binary solid-solid mixture (2.0 gms mixture to be given). 1. Minimum five mixtures to be completed by the students. 2. Components of the mixture should include water soluble and water insoluble acids (carboxylic acid), water insoluble phenols(2-naphthol, 1-naphthol), water insoluble bases	

REFERENCE:

<u>Unit I and II</u>

Physical chemistry :

1. Advanced Practical Physical Chemistry, Author: J.B. Yadav Publisher: Goel Publishing House
2. Practical Physical Chemistry, Author: B. Viswanathan & P.S. Raghavan, Publisher: Viva Books.
3. Comprehensive Practical Physical Chemistry, Authors: V.K. Ahluwalia & Sunita Dhingra.
4. Laboratory Manual of Physical Chemistry, Author: S.H. Maron & C.F. Prutton.
5. Experiments in Physical Chemistry, Authors: Shoemaker, Garland & Nibler.
6. Skoog et al. “Fundamentals of Analytical chemistry" Cengage Learning, Eight Edition.
7. Day and Underwood, “Quantitative analysis" prentice hall 1991, chapter3

Inorganic Chemistry:

1. Vogel's Textbook of Inorganic Quantitative Analysis"
   By G. Svehla 7TH Edition 2012
2. "A Textbook of Practical Inorganic Chemistry"
   By A.I. Vogel, B. Sivasankar (adapted edition)
3. "Practical Inorganic Chemistry"
   By G. Pass and H. Sutcliffe 1974
4. " Experimental Inorganic Chemistry"
   By W. G. Palmer 1962"Selected Experiments in Inorganic Chemistry"
   By W. L. Jolly
5. "Advanced Practical Inorganic Chemistry"

By Gurdeep 2020

6. "Laboratory Manual in Inorganic Chemistry"
   By R. Gopalan, Venkappayya, Nagarajan
7. "College Practical Chemistry" (Inorganic Section)
   By Ahluwalia, Bhagat, and Ramesh, 2005.
8. Practical Inorganic Chemistry Shikha Gulati, J.L. Sharma, Shagun Manocha Edition: 2019.
9. Advanced Practical Inorganic Chemistry Gurdeep Raj, 19th Edition, 2007

Organic chemistry:

1. Practical Organic Chemistry – A. I. Vogel
2. Practical Organic Chemistry – H. Middleton.
3. Practical Organic Chemistry – O. P. Aggarwal

Course Code	Course Title	Credits	Lectures /Week
25CHEMJ514	Introduction to Indian Medicinal Chemistry **(Major Specific IKS)**	**2**	**2**

Course Outcomes: After successful completion of the course, the learner will be able to;

CO1: Comprehend the general stages in drug discovery and design Define and explain the fundamental concepts of drugs, including their definitions, classifications, and general principles of drug discovery.Identify and describe key Indian medicinal plants, including Bhuiavali (Phyllanthus niruri), Hibiscus, Adulsa (Justicia adhatoda), Mothi-Ringnee (Solanum trilobatum), Tulasi, Brahmi, Aloe Vera, Neem, and Sadafuli, with their botanical characteristics and vernacular names.

CO2: Analyse between leads, analogues and drugs..Explain the traditional and pharmacological uses of Indian medicinal plants in treating various ailments, based on Ayurvedic and modern phytotherapeutic knowledge.

CO3: Describe chemical constituents and medicinal uses of various medicinal plants.

CO4: Illustrate the methods of extraction, characterization, and applications of essential oils derived from Indian medicinal plants.

Unit	Topics	No of Lectures
I	**An introduction to drugs and their discovery** 1.1 Drug discovery and design: a historical outline- General stages in modern-day drug discovery and design 1.2 Leads and analogues: some desirable properties- Bioavailability, Solubility, Structure, Stability 1.3 Sources of leads and drugs: Ethnopharmaceutical sources, Plant sources, Marine sources, Microorganisms, Animal sources.	**15**

II	**Indian medicinal plants and essential oils** 2.1 Indian Medicinal Plants: Bhuiavali (Phyllanthus niruri), Hibiscus, Adulsa (Justicia adhatoda), Mothi-Ringnee (Solanum trilobatum), Tulasi, Brahmi, Aloe Vera, Neem plant and Sadafuli (Catharanthus roseus) (major chemical constituents and medicinal uses). 2.2 Essential Oils: Extraction by steam distillation – Source and medicinal uses of eucalyptus oil, Sandalwood oil and lemon grass oil.	**15**

Reference:

1. Gareth Thomas, Medicinal Chemistry: An Introduction, 2nd edition, John Wiley and Sons Ltd., The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England, 2007, ISBN 978-0-470-02598-7.
2. Burger's Medicinal Chemistry and Drug Discovery, 6th edition, Volume 1: Drug Discovery, edited by Donald J. Abraham, A John Wiley and Sons, Inc., Publication, 2003, ISBN 0-471-27090-3.
3. James A. Duke with Mary Jo Bogenschutz-Godwin, Judi duCellier, Peggy-Ann K. Duke, Handbook of Medicinal Herbs, 2nd edition, CRC Press LLC, 2002.
4. C. P. Khare, Indian Medicinal Plants- An Illustrated Dictionary, Springer Science & Business Media, LLC, 2007, ISBN: 978-0-387-70637-5 Springer-Verlag Berlin/Heidelberg.

Course Code	Course Title	Credits	Lectures /Week
25CHEEL511	**Dyes (T) Elective**	**2**	**2**

Course Outcomes:

CO1 : To remember the definitions of dyes, natural and synthetic dyes, primaries, dye intermediates, and abbreviations (suffixes) used in the nomenclature of commercial dyes.

CO2 : To understand the basic categories of dyes based on applicability on substrates and on their chemical structure.

CO3 : To apply synthetic methods to prepare dye intermediates and selected dyes using various chemical reactions.

CO4 : To analyse various theories explaining the colour of compounds ,to analyse the diverse applications of dyes beyond the textile industry, to analyze the challenges and opportunities faced by Indian Dyestuff Industry.

Unit	Topics	No of Lectures
I	**Dye Chemistry: Application-based Classification, Colour-Chemical**	**15**

	Constitution of Dyes,and Synthesis of Dye Intermediates. Definition of Dyes, Requirements of a g ood dye, Abbreviations (Suffixes) used in the nomenclature of commercial dyes : G, R, B, L, S, K, 6B, GK, 6GK. Natural Dyes: Definition and limitations of natural dyes.Examples and uses w.r t. Henna, Turmeric, Saffron,Madder,Indigo- names of the chief colouring matter in each natural dye [structures not expected] Synthetic Dyes : Definition of synthetic dyes, primaries and dye Intermediates. Dyeing methods of fibres : i) Direct dyeing ii) Vat dyeing iii) Mordant dyeing iv) Disperse dyeing . Classification of dyes based on applicability on substrates [examples with structures]. a) Acid dyes-Orange II b) Basic dyes-Methyl Violet c) Direct dyes-Benzofast Yellow 5GL d) Azoic dyes- Diazo components : Fast Yellow G,Fast Orange R Coupling components : Naphthol AS , Naphthol ASG e) Mordant dyes- Eriochrome Black A, Alizarin f) Vat dyes- Indanthrene Brown RRD g) Disperse dyes- Celliton Fast Brown 3R. Relation between colour and chemical constitution i) Armstrong's Theory (Quinonoid Theory) and its limitations ii) Witt's Theory iii) Valence Bond Theory : Comparative study and relation of colour in the following classes of compounds-Benzene, Nitrobenzene, Nitroanilines, Nitrophenols iv) Molecular Orbital Theory Synthesis of Dye Intermediates - i)Benzene derivatives: Benzenesulphonic acid, Sulphanilic acid, o,m,p-Phenylene diamines, ii)Naphthalene Derivatives: Naphthionic acid, Cleve-6-acid,H-acid.	
II	**Chemical classification and Synthesis of Selected Dyes, Non-Textile applications of dyes ,and the Indian Dyestuff Industry.** 1.1 Classification of Dyes based on Chemical Constitution and Synthesis of Selected Dyes : i) Nitro Dye : Naphthol Yellow S ii) Nitroso Dye : Gambine Y iii) Azo dyes a) Monoazo dyes : Orange IV (from sulphanilic acid) b) Bis azo dye : Congo Red (from nitrobenzene) iv) Diphenylmethane dye : Auramine O (from N,N- dimethyl aniline) v) Triphenylmethane dye : a) Diamines series: Malachite Green (from benzaldehyde) b) Triamine series: Acid Magenta c) Phenol series: Rosolic acid vi) Heterocyclic Dyes a) Thiazine dyes : Methylene blue b) Azine dyes : Safranine T c) Xanthene dyes : Eosin (from resorcinol and phthalic anhydride) d) Oxazine dyes : Capri Blue viii) Indigoid Dyes : Indigo (from aniline + monochloroacetic acid) 1.2 Non-Textile applications of dyes i) Dyes used in formulations: Sunset yellow,Tartrazine ii) Dyes used in food and cosmetics : Properties of dyes used in food and cosmetics, Introduction to FDA and FSSAI, Duties and	**15**

	Responsibilities of FDA and FSSAI. Commonly used food colours : Erythrosin, Tartrazine, Orange I iii) Paper and Leather dyes : i) Structural features of paper and leather ii) Dyes applicable to paper and leather iv) Dyes used as Indicators. 1.3 Dyestuff Industry: Indian Perspective i) Growth and development of the Indian Dyestuff Industry ii) Strengths,Weaknesses, Opportunities and Challenges of Dyestuff industry in India iii) Make in India - Future Prospects of the Dye Industry.	

Reference:

Unit I and II

1. Synthetic Dyes by Gurudeep R.Chatwal,Himalaya Publishing House.
2. Synthetic Dyes y Dr Ritu Singh.
3. A Textbook of Synthetic Dyes by O.D.Tyagi and M.Yadav.
4. Synthetic Dyes by Rajbir Singh, Mittal Publications.
5. The Chemistry of Synthetic Dyes Volume V edited by K.Venkatraman.
6. Dyes and Pigments by Ghazala Yakub and Haleema Sadia.
7. New trends in Natural Dyes for Textiles (The Textile Institute Book Series)1 by Vankar,Dr.Padma Shree,Shukla,Dhara.
8. Paper and Colour : Dyes and Dyeing around the world edited by Radha Pandey.
9. The Colour Science of Dyes and Pigments by K. Maclaren.
10. Dyeing and Dyestuff by Grierson.

Course Code	Course Title	Credits	Lectures/ Week
25CHEEL51P	**Dyes (P) (Elective)**	**2**	**4**

Course Outcomes:

CO1: To recall the process of extracting natural dye,and to recognise the steps involved in dyeing cotton fabric by Direct dyeing method.

CO2 : To explain the fundamental principles behind the preparation of dye intermediates and dyes, such as nitration,diazotization, sulfonation reactions.

CO3 : To perform titrimetry and colorimetry analysis to determine the concentration of dyes, using appropriate reagents.

CO4 : To examine results from TLC and Paper chromatography to identify the individual components in the synthetic dye mixture or natural pigments.

Unit	Topics	No of hours
1	To prepare m-Dinitrobenzene from nitrobenzene.	
2	To prepare Orange II from sulphanilic acid.	
3	To prepare Phthalimide from phthalic anhydride using urea.	

4	To prepare Malachite Green from benzaldehyde and N,N-dimethylaniline.	
5	To prepare Fluorescein from phthalic anhydride.	
6	To prepare Sulphanilic acid from aniline.	
7	To separate the components of natural pigments by paper chromatography (e.g.Chlorophyll).	
8	To separate dye mixture (Safranine T,Indigo carmine,Methylene blue) by Thin Layer Chromatography TLC.	
9	To estimate dye content in a cationic dye sample using potassium dichromate titration.	
10	To estimate the amount of Methyl Orange present in the given solution by Colorimetry.	
11	To dye a given cotton fabric by direct dyeing method.	
12	To determine the concentration of Hibiscus Dye via Colorimetric Analysis.	
13	Extraction of Natural Dye from Beetroot and Testing Its Dyeing Ability on Fabric.	
14	To determine the concentration of synthetic dye (Tartrazine or Sunset Yellow) in a soft drink using Titrimetric Analysis.	
15	To determine the concentration of crystal violet in a commercial sample using a calibration curve method.	

References :
1) A Handbook of Synthetic Dyes by Rajbir Sing.
2) The dyeing of cotton fabrics by Franklin.
3) Vogel's Textbook of Practical Organic Chemistry.
4) Practical Organic Chemistry by Dr.L.Rakesh Sharma.
5) Practical Chemistry by OP Pandey,DN Bajpai,S Giri.

Course Code	Course Title	Credits	Lectures /Week
25CHEEL512	Heavy & Fine Chemicals – I ELT-2	**4**	**4**

Course Outcomes:

CO1: To know the classification, importance, and roles of various chemical industries including bulk and specialty chemical sectors.

Classify common pharmaceutical drugs and describe their synthesis and therapeutic uses, demonstrating foundational knowledge in medicinal chemistry.

CO2: Describe the structure, types, and preparation of silicates and industrial chemicals such as talcum powder, nitric acid, sodium dichromate, and chromium trioxide along with their applications.

Explain the chemical nature, classification, synthesis, and applications of perfumes, flavors, and sweeteners, with an emphasis on natural and synthetic compounds.

Illustrate the manufacturing processes and industrial applications of key organic solvents, and develop an understanding of green chemistry principles through the study of green solvents.

Understand the significance of fluoroaromatics, and describe the reagents and reactions used in their synthesis including Halex and Super Halex reactions.

CO3: Identify and compare various pumps and vacuum systems used in chemical industries for fluid and gas handling, including their working principles and applications.

CO4: Demonstrate knowledge of manufacturing processes, properties, and uses of common fertilizers, and understand their role in agriculture and industry.

Analyze the economic and practical considerations involved in establishing a chemical industry, including site selection, resource availability, and ecological impact.

Unit	Topics	No of Lectures
I	1.1 Introduction to Chemical Industry. Explanation of the terms Heavy (Bulk) and Fine (Specialty) Chemicals. 3L 1.2 Silicates: a) Introduction to silicates: Properties, structure and types of silicates. Preparation of sodium silicate. 4L 1.3 Manufacture and applications of the following: - a) Talcum powder b) Nitric acid 4L c) Sodium dichromate d) Chromium trioxide 4L	**15**
II	2.1: Pumps for chemical work Introduction of pumps a) Pumping equipment for liquids — piston pump, diaphragm pump, gear pump. Centrifugal pumps and submersible pumps. (7L) b) Vacuum systems oil sealed pumps and ejectors. (4L)	**15**

	2.2 Fertilizers: Preparation, properties and uses of (4L) a) Normal superphosphate b) Triple Superphosphate c) Ammonium nitrate d) Ammonium Sulphate	
III	3.1 Brief idea about the economic aspects of chemical manufacturing processes with respect to Location, Raw materials, Energy, Capital, Manpower, Ecological aspects, Tax benefits. Writing a Project Report for setting up an Industry 6L 3.2 Brief account of perfumes, flavours and sweeteners: a)Perfumes: Introduction, classification (ethers, esters and essential oils) Composition, formation, blending and applications. Synthesis of α and β -ionone's from citral . 3L b)Flavours: Introduction,Classification (natural and synthetic), applications of Vanillin,Coumarin(structures),Synthesis of Vanillin. 3L c)Sweeteners: Introduction, classification with e xamples and structures of :-A) Natural sweetners : Carbohydrates(Glucose, Fructose) B)Synthetic sweeteners: i)Sucralose, i)Sulphonamide: eg Saccharin, iii) Peptides: Aspartame, Synthesis of Saccharin . 3L	**15**
IV	4.1: Industrial solvents: - Manufacture and uses of ethyl acetate ,isopropyl alcohol, Acetone, Acetic acid, Dimethyl formamide, Brief idea of green solvents. 6L 4.2 : Introduction to drugs: Terminology,Classification with one example each. Synthesis and uses of the following :- 1) Ethambutol 2) Mebendazole 3) Benadryl 4) Ibuprofen 5) Miconidazole 6) Diazepam 6L 4.3:Fluoroaromatics:Introduction, important reagents used for fluorination, Halex reaction, Super Halex reaction, Preparation of ortho-fluorotoluene and 3-chloro-4-fluoro aniline.. 3L	**15**

Reference:

Unit I and II

1. C. D. Dryden: Outlines of Chemical Technology, edited & revised by M. Gopala Rao & Marshall Sittig East West Press, New Delhi.
2. Faith Keyes and Clerk's Industrial Chemicals, 4th Edn., Wiley Inter-science 1975.
3. Foust A. S. et-al.: Principles of Unit Operations John Wiley & Sons.
4. Macabe W.L., Smith J. C. and Harriott. P. Unit Operations of Chemical Engineering (7th edition) (McGraw Hill Chemical Engineering series).
5. P. H. Groggins: Unit Processes in Organic Synthesis, McGraw Hill.
6. Kirk & Othmer: Encyclopeadia of Chemical Technology, John Wiley and sons.
7. A. I. Vogel: Text book of Quantitative Analysis including Instrumental Analysis.
8. A. I. Vogel: Text book of Quantitative Organic Analysis.
9. Industrial Inorganic Chemistry-Buchner, Schliebs, Winter, translated by D. H. Tenell, VCH Publishers, New York.
10. Industrial Organic Chemistry- K. Welssermel, H. J. Arpe, VCH Publishers, New York.
11. B.Pearson- Speciality Chemical Innovations in Industrial Synthesis.

12. Text Book of Organic Medicinal and Pharmaceutical Chemistry Wilson & Giswold
13. Text Book of Pharmacology – Satoskar & Bhandarkar.
14. The Chemistry of Synthetic Dyes – Edited by K. Venkatraman. Academic press Inc. London.
15. Shreeves 'Chemical Process Industries' 5th Edition, G. T. Oustin, McGraw Hill.
16. Industrial Chemistry- B. K. Sharma, Goyal publishing house, Mirut.
17. Riegel's Hand Book of Industral Chemistry, 9th Edition, Jems A. Kent.
18. Industrial Chemistry- E Stoch, Vol- I, Ellis Horwood Ltd. UK.
19. An Introduction to Industrial Organic Chemistry- Wiseman and Peter, ""
20. Unit Operations and Processes- P. H. Groggins.
21. Unit Operations I and II- P.P. Kale- Pune Vidyarthigruh Prakashan.
22. Unit Operations in Chemical Engineering by W. L. McCabe and Smith.
23. Riegel's Handbook of Industrial Chemistry, J. A. Kent, CBS Publishers, New Delhi
24. Riegel's Handbook of Industrial Chemistry, James A. Kent, 7th Edition, Van Nostrand Reinhold Company.
25. Shreeves 'Chemical Process Industries' 5th Edition, G. T. Austin, McGraw Hill, 1984.

Course Code	Course Title	Credits	Lectures /Week
25CHEMN521	**Chemistry Minor Theory**	**2**	**2**

Course Outcomes:

CO1:

- Define the basic concepts of spectroscopy, interaction of electromagnetic radiation with matter
- To remember the electronic configuration of elements from group 16 and 17.
- To study the basic definitions of terms related to organic reactions.

CO2:

- Illustrate and compare Vibrational, Rotational and Raman spectroscopic techniques.
- To understand trends in properties and allotropy of Group-16/Group-17 elements
- Understand basic principles of organic reaction mechanisms.

CO3:

- Apply the knowledge of molecular spectroscopy
- To study VSEPR theory for Group-17 elements.
- Apply fundamentals of Organic Reaction Mechanism to various reactions.

CO4:

- Analyze molecular spectra and nuclear radiation.
- To analyse the interhalogens based on VSEPR theory.
- Analyzing the stereochemical outcomes of various organic reaction mechanisms

Unit	Topics	No of Lectures

I	**1.0 MOLECULAR SPECTROSCOPY** (10 L) 1.1 Rotational Spectrum: Introduction to dipole moment, polarization of a bond, bond moment, molecular structure, .Rotational spectrum of a diatomic molecule, rigid rotor, moment of inertia, energy levels, conditions for obtaining pure rotational spectrum, selection rule, nature of spectrum, determination of internuclear distance and isotopic shift. 1.2 Vibrational spectrum: Vibrational motion, degrees of freedom, modes of vibration, vibrational spectrum of a diatomic molecule, simple harmonic oscillator, energy levels, zero point energy, conditions for obtaining vibrational spectrum, selection rule, nature of spectrum. 1.3 Vibrational-Rotational spectrum of diatomic molecule: energy levels, selection rule, nature of spectrum, P and R branch lines. Anharmonic oscillator - energy levels, selection rule, fundamental band, overtones. Application of vibrational-rotational spectrum in determination of force constant and its significance. Infrared spectra of simple molecules like H2O and CO2. **Comparative Chemistry of Group 16 (05 L)** Electronic configurations, trends in physical properties, allotropy Manufacture of sulphuric acid by Contact process.	**15**
II	**Comparative Chemistry of Group 17 (05 L)** Electronic configuration, General characteristics, anomalous properties of fluorine, comparative study of acidity of oxyacids of chlorine w.r.t acidity, oxidising properties and structures (on the basis of VSEPR theory) Chemistry of interhalogens with reference to preparations, properties and structures (based on VSEPR theory) **Mechanism of Organic Reactions: (10L)** The basic terms & concepts: bond fission, reaction intermediates, electrophiles & nucleophiles, ligand, base, electrophilicity vs. acidity & nucleophilicity vs basicity. Neighbouring group participation in nucleophilic substitution reactions**:** participation of lone pair of electrons, kinetics and stereochemical outcome. Acyl nucleophilic substitution (Tetrahedral mechanism): Acid catalyzed esterification of carboxylic acids (AAC2) and base promoted hydrolysis of esters (BAC2). Pericyclic reactions: classification and nomenclature: Electro cyclic reactions (ring opening and ring closing), cycloaddition, sigma tropic Rearrangement.	**15**
Reference: <u>Unit I and II</u> 1. Per Jensen and Philip R. Bunker , Fundamentals of Molecular Symmetry , Series in		

Chemical Physics, Taylor & Francis Group
2. J. S. Ogden, Introduction to Molecular Symmetry, Oxford University Press.loiu
3. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
4. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
5. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
6. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013
7. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
8. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
9. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
10. Richard Harwood, Chemistry, Cambridge University Press,
11. Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand & Co Ltd .
12. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
13. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
14. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
15. J. D. Lee, Concise Inorganic Chemistry, 4thEdn., ELBS,
16. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
17. Gary Wulfsberg, Inorganic chemistry, Viva Books Pvt,.Ltd. (2002).

Course Code	Course Title	Credits	Lectures/ Week
25CHEMN52P	**Chemistry Minor Practical**	**2**	**4**

Course Outcomes: After successful completion of the course, the learner will be able to.

CO1: Understand the basic concept of molecular spectroscopy and chemical thermodynamics. To recall the chemical reactions of qualitative organic analysis of the compounds.

CO2: Illustrate and compare various types of spectroscopies. To understand Solubility Principles. To understand the. Determine chemical type of mixture.

CO3: Apply the knowledge of molecular spectroscopy and chemical thermodynamics. Apply principles of acid-base chemistry to distinguish and separate components based on

their acidic, basic, or neutral properties. To apply theoretical knowledge to separate solid-solid mixture of organic compounds.
CO4: Analyze given sample using molecular spectroscopy and chemical thermodynamics techniques. Analyze and identify organic compounds after separation.

Unit	Topics
1	To estimate the amount of fluoride in a given sample spectroscopically .
2	To determine potassium content of a given sample by flame photometry.
3	To determine the amount of sulphate in a given water sample turbidimetrically.
4	To estimate the amount of Fe +2 by photometric titration using colorimeter.
5	To determine sodium content of a given sample by flame photometry.
6	To prepare potassium diaquo bis(oxalato) cuprate(II)
7	To prepare bis acetylacetonato copper(II).
8	To prepare ferrous ethylene diammonium sulphate.
9	To determine the percentage purity of $CuSO_4.5H_2O$ iodometrically from the binary mixture and detection of cation and anion of the impurity salt.
10	To determine the percentage purity of $NiSO_4.7H_2O$ complexometrically from the binary mixture and detection of cation and anion of the impurity salt.
11	Separation of Binary solid-solid mixture (2.0 gms mixture to be given). 1. Minimum five mixtures to be completed by the students.

	2. Components of the mixture should include water soluble and water insoluble acids (carboxylic acid), water insoluble phenols(2-naphthol, 1-naphthol), water insoluble bases

References:

Physical chemistry practical:

1. Advanced Practical Physical Chemistry, Author: J.B. Yadav Publisher: Goel Publishing House

2. Practical Physical Chemistry, Author: B. Viswanathan & P.S. Raghavan, Publisher: Viva Books

3. Comprehensive Practical Physical Chemistry, Authors: V.K. Ahluwalia & Sunita Dhingra

4. Laboratory Manual of Physical Chemistry, Author: S.H. Maron & C.F. Prutton

5. Experiments in Physical Chemistry, Authors: Shoemaker, Garland & Nibler

Inorganic Chemistry:

1. Vogel's Textbook of Inorganic Quantitative Analysis"
   By G. Svehla 7TH Edition 2012
2. "A Textbook of Practical Inorganic Chemistry"
   By A.I. Vogel, B. Sivasankar (adapted edition)
3. "Practical Inorganic Chemistry"
   By G. Pass and H. Sutcliffe 1974
4. " Experimental Inorganic Chemistry"
   By W. G. Palmer 1962"Selected Experiments in Inorganic Chemistry"
   By W. L. Jolly
5. "Advanced Practical Inorganic Chemistry"
   By Gurdeep 2020
6. "Laboratory Manual in Inorganic Chemistry"
   By R. Gopalan, Venkappayya, Nagarajan
7. "College Practical Chemistry" (Inorganic Section)
   By Ahluwalia, Bhagat, and Ramesh, 2005.
8. Practical Inorganic Chemistry Shikha Gulati, J.L. Sharma, Shagun Manocha Edition: 2019.
9. Advanced Practical Inorganic Chemistry Gurdeep Raj, 19th Edition, 2007

Organic chemistry practical:

1. Practical Organic Chemistry – A. I. Vogel

2. Practical Organic Chemistry – H. Middleton.

3. Practical Organic Chemistry – O. P. Aggarwal

Course Code	Course Title	Credits	Lectures/ Week

25CHEVS54P	Analytical Chemistry Practical (Vocational Skill Course)	2	4

Course Outcomes: After successful completion of the course, the learner will be able to;

CO1: Define the basic concepts of pH, ion exchange phenomenon.

CO2: Illustrate and compare the analytical methods of analysis.
CO3: Apply the knowledge of Analytical methods for analysis of samples .
CO4: Analyse given sample using analytical techniques.

Unit	Topics
1	Estimate the amount of Zn and Mg present in the given sample solution, using an ion exchange resin column.
2	Determination of hardness of water sample using an ion exchange resin column.
3	Determination of Phosphoric acid in cola using Ph meter.
4	Determination of COD of water sample.
5	Estimation of Mg content in talcum powder by complexometry,using standard solution of EDTA.
6	Formula of complex formed between Cupric ion and ammonia by distribution method.
7	Extraction of iron using Amyl alcohol.
8	Separation of Cu2+ and Ni2+ from a mixture using solvent and masking agent.
9	Determination of phenol in water using chloroform solution by solvent extraction method.
10	Estimation of glucose in the honey sample.
11	Determination of Vitamin C by pH metric titration.
12	Estimation of Aluminium in the given Bauxite ore.
13	Estimation of Iron in the given Hematite ore.
14	Estimation of Copper in given Brass alloy.
15	Estimation of Fe in given Steel alloy.

References:

1) A Textbook of Practical Chemistry, Authors: Vogel's (Revised by G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denney)
2) Practical Analytical Chemistry, Author: H. Kaur
3) Laboratory Manual in Analytical Chemistry, Author: S.K. Bhasin & R. Rani

4) Fundamentals of Analytical Chemistry , Authors: Douglas Skoog, Donald West, F.J. Holler

Course Code	Course Title	Credits	Lectures/ Week
25CHEFP611	**Field Project**	**2**	**4**

● **Field Project** comprises the ways of implementing actual field engagement which needs to be determined by respective departments.

Unit	Topics	No of Lectures
I	For a 60-hour field project suitable for undergraduate chemistry students, the scope should be manageable but still hands-on and educational. Below are some field project ideas categorized by theme, each designed to be completed within ~2 weeks (assuming 4–5 hours per day) 1. Water Quality Assessment of a Local Source Activities: • Collect water samples from 3–5 sources (e.g., river, borewell, tap water). • Test for pH, turbidity, hardness, dissolved oxygen (DO), BOD/COD, and presence of heavy metals. • Compare with WHO/BIS standards and prepare a report. Skills Gained: Water analysis, titrations, spectrophotometry, report writing. 2. Soil Analysis for Agricultural Suitability Activities: Collect soil samples from farms or gardens.	30

	Analyze pH, NPK content, organic matter, and moisture content. Suggest crop suitability and fertilizer use. (Skills Gained: Soil chemistry, gravimetric and volumetric analysis, lab-to-field correlation.) 3. Food Adulteration Detection in Local Market Samples Activities: • Collect samples of milk, honey, spices, oils. • Conduct simple chemical tests for common adulterants (starch, urea, vanaspati, synthetic colors). • Educate a local community about food safety. (Skills Gained: Qualitative analysis, food chemistry, public communication.) **1.** Extraction and Study of Natural Dyes from Plants Activities: • Collect local plants (turmeric, hibiscus, spinach, beetroot). • Extract dyes using water/alcohol-based methods. • Test dye stability on different fabrics and pH sensitivity. (Skills Gained: Extraction techniques, acid-base chemistry, dye application.) Waste Segregation and Plastic Type Identification Activities: • Visit waste collection sites or households. • Sort plastic waste and identify polymer types using simple burning tests or density methods.	

	• Suggest recycling or repurposing strategies. (Skills Gained: Polymer identification, sustainability awareness, recycling practices.)	

SEM VI

Course Code	Course Title	Credits	Lectures/Week
25CHEMJ611	**Paper I PHYSICAL CHEMISTRY**	**2**	**2**

Course Outcomes: After successful completion of the course, the learner will be able to;

CO1: Define the basic concepts of electrochemistry, Activity and Activity Coefficient, Classification of cells,Polarization, Basic terms of Polymer chemistry. Relate the different types of cells with and without transference, Molar masses of polymers, Number average, Weight average, Viscosity average molar mass.

CO2: Illustrate and compare Lewis's concept and Debye- Huckel limiting law, Chemical cells and Concentration cells. Chemical cells with and without transference, Decomposition Potential and Overvoltage. Explain phenomenon of Light Emitting Polymers,

CO3: Apply the knowledge of Electrochemistry chemistry and Polymer chemistry.

CO4: Analyse given sample by applying potentiometric technique.

Unit	**Topics**	No of Lectures
I	**ELECTROCHEMISTRY** 1.1 Activity and Activity Coefficient: Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. Debye-Huckel limiting law (No derivation) 1.2 Classification of cells: Chemical cells and Concentration cells. Chemical cells with and without transference, Electrode Concentration cells, Electrolyte concentration cells with and without transference (derivations are expected), 1.3 APPLIED ELECTROCHEMISTRY : Polarization: concentration polarization and it‟s elimination. Decomposition Potential and Overvoltage : Introduction, experimental determination of decomposition potential, factors affecting decomposition potential. Tafel‟s equation for hydrogen overvoltage, experimental determination of over – voltage (Numerical problems are expected)	**15**
II	**POLYMERS** 2.1 Basic terms : macromolecule, monomer, repeat unit, degree of polymerization. 2.2. Classification of polymers: Classification based on source, structure, thermal response and physical properties 2.3. Molar masses of polymers: Number average, Weight average, Viscosity average molar mass, Monodispersity and Polydispersity 2.4. Method of determining molar masses of polymers :Viscosity method using Ostwald Viscometer. (derivation expected)	**15**

	2.5 Light Emitting Polymers : Introduction, Characteristics, Method of preparation and applications 2.6. Antioxidants and Stabilizers : Antioxidants , Ultraviolet stabilizers, Colourants, Antistatic agents and Curing agents.	

References:
Unit I and II

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.
3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, Inc [part 1]
4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer
6. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
10. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
11. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.
12. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.
13. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan, New Age International (P) Ltd., Publishers, 2011.
14. Chemical Kinetics, K. Laidler, Pearson Education India, 1987.
15. Practical Physical Chemistry 3rd edition A.M.James and F.E. Prichard , Longman publication
16. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
17. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
18. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
19. Experimental Physical Chemistry By V.D.Athawale.
20. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A. Gulati, R Chand and Co.. 2011

Course Code	Course Title	Credits	Lectures/Week

25CHEMJ612	**PAPER II INORGANIC CHEMISTRY**	**2**	**2**

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

CO1-:

- To remember the VBT for coordination compounds, definition of thermodynamic and kinetic stability, inert and labile complexes
- To know about organometallic compounds and their types, metallocene,ferrocene etc.
- To know about catalysis and it's type

CO2:

- To understand the CFT, splitting of d-orbitals in various crystal fields, limitations of CFT, evidence for covalency in metal complexes, factors affecting stability of complexes, origin of electronic spectra, types of electronic transitions.
- To understand about synthesis and reactions of organometallic compounds as well ferrocene and their reactions
- To understand the basic steps involved in the catalysis process.

CO3:

- To apply CFT and CFSE calculations for Octahedral complexes, Stepwise and overall stability constants, ligand substitution reactions.
- To study the mechanism of hydrogenation of alkene using Wilkinson's Catalyst as per basic steps involved in the catalysis process.

CO4:

- To analyse the impact of ligands in CFT and CFSE, factors affecting thermodynamic stability

Unit	Topics	No of Lectures
I	**1.Theories of the metal-ligand bond (I)** 1.1 Limitations of Valence Bond Theory. 1.2 Crystal Field Theory and effect of crystal field on central metal valence orbitals in various geometries from linear to octahedral(from coordination number 2 to coordination number 6) 1.3 Splitting of *d* orbitals in octahedral, square planar and tetrahedral crystal fields.	15

	1.4 Distortions from the octahedral geometry : (i) effect of ligand field and (ii) Jahn-Teller distortions. 1.5 Crystal field splitting parameters Δ ; its calculation and factors affecting it in octahedral complexes, Spectrochemical series. 1.6 Crystal field stabilization energy(CFSE), calculation of CFSE for octahedral complexes with d^0 to d^{10} metal ion configurations. 1.7 Consequences of crystal field splitting on various properties such as ionic radii, hydration energy and enthalpies of formation of metal complexes of the first transition series. 1.8 Limitations of CFT : Evidence for covalence in metal complexes intensities of d-d transitions, (ii) ESR spectrum of $[IrCl6]^{2-}$ (iii) Nephelauxetic effect.	
II	**Organometallic Chemistry** **2.1 Organometallic Compounds of main group metal** 2.1.1 General characteristics of various types of organometallic compounds, viz.ionic, σ-bonded and electron deficient compounds. 2.1.2 General synthetic methods of organometallic compounds : (i) Oxidative-addition, (ii)Metal-metal exchange(transmetallation), (iii) Carbanion-halide exchange, (iv) Metal-hydrogen exchange(metalation) and (v) Methylene-insertion reactions. 2.1.3 Some chemical reactions of organometallic compounds: (i) Reactions with oxygen and halogens, (ii) Alkylation and arylation reactions (iii) Reactions with protic reagents, (iv)Redistribution reactions and (v) Complex formation reactions **2.2 Metallocenes** Introduction, Ferrocene : Synthesis, properties, structure and bonding on the basis of VBT. **2.3 Catalysis**	**15**

	2.3.1 Comparison between homogeneous and heterogeneous catalysis 2.3.2 Basic steps involved in homogeneous catalysis 2.3.3 Mechanism of Wilkinson's catalyst in hydrogenation of alkenes.	

References:

1. Geoffrey A. Lawrance Introduction to Coordination Chemistry John Wiley & Sons.
2. R. K. Sharma Text Book of Coordination Chemistry Discovery Publishing House
3. R. Gopalan , V. Ramalingam Concise Coordination Chemistry , Vikas Publishing House;
4. Shukla P R, Advance Coordination Chemistry , Himalaya Publishing House
5. Glen E. Rodgers, Descriptive Inorganic, Coordination, and Solid-State Chemistry Publisher: Thomson Brooks/Cole
6. Ramesh Kapoor and R.S. Chopra, Inorganic Chemistry, R. Chand publishers,
7. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY,
8. Twigg ,Mechanisms of Inorganic and Organometallic Reactions
    a. Publisher: Springer
9. R.K. Sharma Inorganic Reaction Mechanisms Discovery Publishing House
10. M. L. Tobe Inorganic Reaction Mechanisms Publisher Nelson, 1972
11. Cotton, Wilkinson, Murillo and Bochmann, Advanced **Inorganic Chemistry**, 6th Edition..
12. H.W. Porterfield, Inorganic Chemistry, Second Edition, Academic Press, 2005
13. Purecell, K.F. and Kotz, J.C., Inorganic Chemistry W.B. Saunders Co. 1977.
14. Robert H. Crabtree ,The Organometallic Chemistry of the Transition Metals, Publication by John Wiley & Sons
15. B D Gupta & Anil J Elias Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University press
16. Ram Charan Mehrotra, Organometallic Chemistry: A Unified Approach, New Age International.
17. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
18. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
19. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
20. Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi.
21. Puri ,Sharma Kalia Inorganic chemistry. Chapter 10, Metals and metallurgy.(328-339)
22. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
23. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
24. Satya Prakash, G.D.Tuli, R.D. Madan , Advanced Inorganic Chemistry.S. Chand & Co Ltd

Course Code	Course Title	credits	lectures /week
25CHEMJ613	**PAPER III ORGANIC CHEMISTRY**	**2**	**2**

CO1:
Define organic spectroscopic techniques and recall the basics of electromagnetic radiations. remember the definitions and types of polymers, catalysts and reagents.

CO2:
Understand the concept of spectroscopic techniques like UV-Visible, IR, NMR. To understand the reactions of polymerization, also including various reagents and catalysts.

CO3:
Apply the knowledge of basic chemistry in organic spectra and to know the applicational chemistry of polymers. To apply knowledge of usage of catalysts and reagents in various functional group transformations.

CO4:
Analyse the given spectral data to know the structural features of organic compounds. To solve the combined spectral problems.

UNIT	TOPICS	No of Lectures
I	**Organic Spectroscopy** **Introduction:** Electromagnetic spectrum, units of wavelength and frequency **UV – Visible spectroscopy:** Nature of UV-Visible spectrum, concept of chromophore, auxochrome, bathochromic and hypsochromic shifts, hyperchromic and hypochromic effects, chromophore-chromophore and chromophore-auxochrome interactions. **Mass spectrometry:** Basic theory. Nature of mass spectrum, General rules of fragmentation. Importance of molecular ion peak, isotopic peaks, base peak, nitrogen rule, rule of 13 for determination of empirical formula and molecular formula. Fragmentation of alkanes and aliphatic carbonyl compounds.	15

	IR Spectroscopy: Basic theory, nature of IR spectrum, selection rule, fingerprint region. **PMR Spectroscopy:** Basic theory of PMR, nature of PMR spectrum, chemical shift (d unit), standard for PMR, solvents used. Factors affecting chemical shift: (1) inductive effect (2) anisotropic effect (with reference to C=C, C≡C, C=O and benzene ring). Spin- spin coupling and coupling constant. application of deuterium exchange technique. application of PMR in structure determination. Problems of structure elucidation of simple organic compounds using individual or combined use of UV-Vis, IR, Mass and NMR spectroscopic techniques are expected. (Index of hydrogen deficiency should be the first step in solving the problems).	
II	**Polymer** **Introduction:** terms monomer, polymer, homopolymer, copolymer, thermoplastics and thermosets. **Addition polymers:** polyethylene, polypropylene, teflon, polystyrene, PVC, Uses. **Condensation polymers:** polyesters, polyamides, polyurethanes, polycarbonates, phenol formaldehyde resins.Uses Stereochemistry of polymers: Tacticity, mechanism of stereochemical control of polymerization using Ziegler Natta catalysts. **Natural and synthetic rubbers**: Polymerisation of isoprene: 1,2 and 1,4 addition (cis and trans), Styrene butadiene copolymer. **Additives to polymers:** Plasticisers, stabilizers and fillers. **Biodegradable polymers:** Classification and uses. polylactic acid structure, properties and use for packaging and medical purposes. (Note : Identification of monomer in a given polymer & structure of polymer for a given monomer is expected. condition for polymerization is not expected) **Catalysts and Reagents**	15

	Study of the following catalysts and reagents with respect to functional group transformations and selectivity (no mechanism). **Catalysts:** **Catalysts for hydrogenation:** Raney Nickel Pt and PtO2 (C=C, CN, NO2, aromatic ring) Pd/C : C=C, COCl→CHO (Rosenmund) Lindlar catalyst of alkynes **Reagents:** LiAlH4 (reduction of CO, COOR, CN,NO2) NaBH4 (reduction of CO) SeO2 (Oxidation of CH2 alpha to CO) mCPBA (epoxidation of C=C) NBS (allylic and benzylic bromination)	

REFERENCE:

<u>Unit I and II</u>

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: London, 1994.
6. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
7. Organic spectroscopy (Second edition),Jag Mohan ,Narosa publication
8. Spectroscopy, Pavia, Lampman, Kriz,Vyvyan.

9. Elementary organic spectroscopy (Third edition), Y.R.Sharma, S.Chand publication..
10. Introduction to spectroscopy (third edition), Pavia, Lampman, Kriz,john vondeling, Emily Barrosse.
11. Organic chemistry Paula Y. Bruice, Pearson education.
12. Spectral identification of organic molecules by Silverstein.
13. Absorption spectroscopy of organic molecules by V.M.Parikh.
14. Polymer chemistry by M.G.Arora, K.Singh.
15. Polymer science – a text book by Ahluwalia and Mishra
16. Introduction to polymer chemistry - R.Seymour, Wiley Interscience.
17. Organic chemistry by Francis Carey – McGrawHill .
18. Organic chemistry by Carey and Sundberg, Part A & B
19. Organic Chemistry by Norman and Coxon

Course Code	Course Title	Credits	Lectures /Week
25CHEMJ614	**PAPER IV ANALYTICAL CHEMISTRY**	**2**	**2**

Course Outcomes: After successful completion of the course, the learner will be able to;
CO1: Define the Classification of analytical methods, types of sampling, terms involved in titrimetric calibration.

CO2: Illustrate and compare Macro, semi-micro and micro analysis

CO3: Apply the knowledge of Macro, semi-micro and micro analysis for the sample analysis.

CO4: Analyse given sample by using analytical technique.

UNIT	TOPICS	No of Lectures

I	Introduction to Analytical Chemistry and Statistical Treatment of analytical data-I 1.1. Role of Analytical Chemistry 1.1.1. Language of analytical chemistry: important terms and their significance in Analytical Chemistry. 1.1.2. Purpose of Chemical Analysis; Analysis based on– (i) the nature of information required (Proximate, Partial, Trace, Complete Analysis) and (ii) the size of the sample used (Macro, semi-micro and micro analysis) 1.1.3. Classical and Non-Classical Methods of Analysis; their types and importance. 1.2. Significance of Sampling in Analytical Chemistry 1.2.1. Terms involved in Sampling 1.2.2. Types of Sampling 1.2.3. Sampling techniques 1.3. Results of Analysis 1.3.1. Errors in Analysis and their types 1.3.2. Precision and Accuracy in Analysis 1.3.3. Corrections for Determinate Errors (Problems including Numericals expected wherever required)	15
II	Classical Methods of Analysis 2. Classical Methods of Analysis. 2.1. Titrimetric Methods 2.1.1. Terms involved in Titrimetric methods of analysis. Comparing, Volumetry and Titrimetry	15

	2.1.2. The Conditions suitable for titrimetry 2.1.3. Types of titrimetry–Neutralisation (Acidimetry, alkalimetry), Redox, (Iodometry, Iodimetry,) Precipitation and Complexometric titrations and indicators used in these titrations 15L 2.1.4. Tools of Titrimetry: Graduated glasswares and Callibration 2.2. Standard solutions (Primary and Secondary standards in Titrimetry) and Calculations in Titrimetry. 2.3. Neutralisation Titrations 2.3.1. Concept of pH and its importance in Neutralisation Titrations 2.3.2. End point and Equivalence point of Neutralisation titrations 2.3.3. Determination of End point by using i. Indicators causing colour change ii. Change in potential, (by potentiometry) iii. Change in conductance (by conductometry) 2.3.4. Construction of titration curve (on the basis of change in pH)of a titration of i. Strong acid-weak base ii. Strong baseweak acid 2.4. Gravimetric analysis 2.4.1. General Introduction to Gravimetry. 2.4.2. Types of Gravimetric Methods. 2.4.3. Precipitation Gravimetry: i. Steps involved in precipitation gravimetry analysis ii. Conditions for	

	precipitation iii. Completion of precipitation, iv. Role of Digestion, Filtration, Washing, Drying Ignition of precipitate. v. Applications of Gravimetric Analysis: Determination of sulfur in organic compounds; Estimation of Nickel in Cu-Ni alloy using dimethyl glyoxime; Determination of Aluminum by converting it to its oxide.	

REFERENCE:

Unit-I

1. Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch

2. Instrumental methods of analysis by Willard, H.H.; Merritt, L.L. Jr.;

Dean, J.A.; Settle,7th Edition

3. Fundamental of Analytical Chemistry by Douglas A. Skoog, West, F. James Holler,

S. R. Crouch

4. Modern Analytical Chemistry by David Harvey, McGraw-Hill Higher Education

Unit-II

1) Skoog et al. “Fundamentals of Analytical chemistry" Cengage Learning, Eight Edition, chapter 13,

14 and 15

2) Day and Underwood, “Quantitative analysis" prentice hall 1991, chapter3

3) S.M. Khopkar, “ Basic Concepts of Analytical Chemistry”, IInd Edition NewAge International

Publisher

4) 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

6) Modern Analytical Chemistry , David Harvey (page numbers 232 -265)

Course Code	Course Title	Credits	Lectures/ Week
25CHEMJ61P	**CHEMISTRY MAJOR PRACTICAL**	**2**	**4**

Course Outcomes: After successful completion of the course, the learner will be able to;

CO1: Understand the basic concept of electrochemistry and polymer chemistry. To recall organic separation techniques.

CO2: Illustrate and compare various types of chemical cells. To understand the chemistry behind the chemical type of mixture.

CO3: Apply the knowledge of electrochemistry and polymer chemistry. To apply theoretical knowledge to separate solid-liquid and liquid-liquid mixtures of organic compounds.

CO4: Analyze given sample using electrochemistry and polymer chemistry. Analyze and identify organic compounds after separation.

Unit	Topics
1	To determine the amount of chloride Bromide and Iodide in the mixture by potentiometric titration.
2	To determine the number of electrons in the redox reaction between ferrous ammonium sulphate and Ceric sulfate potentiometrically.
3	To determine the molecular weight of PVA by viscometry method.
4	To determine the molecular weight of polyethylene glycol by viscometry method.
5	To determine the amount of acetic acid in the given mixture by using quinhydrone electrodes potentiometrically.
6	To prepare Tris(acetylacetonato)iron(III)
7	To prepare Bis(dimethylglyoximato)nickel(II) complex using nickel carbonate and dmg by green synthesis.

8	To determine the percentage purity of PbNO3 complexometrically from the binary mixture and detection of cation and anion of the impurity salt.
9	To determine the percentage purity of MgSO4.7H2O complexometrically from the binary mixture and detection of cation and anion of the impurity salt.
10	To determine the percentage purity of CaCl2.2H2O complexometrically from the binary mixture and detection of cation and anion of the impurity salt.
11	Separation of Binary solid-liquid and liquid-liquid mixture (6-10 ml mixture to be given). 1. Minimum five mixtures to be completed by the students. Components of the mixture should include volatile liquids, non-volatile liquids and solid soluble in volatile liquids.

References:

Physical chemistry practical

1. Laboratory Manual of Physical Chemistry, Author: S.H. Maron & C.F. Prutton
2. Experiments in Physical Chemistry, Authors: Shoemaker, Garland & Nibler
3. Advanced Practical Physical Chemistry, Author: J.B. Yadav Publisher: Goel Publishing House
4. Practical Physical Chemistry, Author: B. Viswanathan & P.S. Raghavan, Publisher: Viva Books
5. Comprehensive Practical Physical Chemistry, Authors: V.K. Ahluwalia & Sunita Dhingra
6. Skoog et al. “Fundamentals of Analytical Chemistry" Cengage Learning, Eight Edition.
7. Day and Underwood, “Quantitative analysis" prentice hall 1991, chapter3

Inorganic Chemistry:

1. Vogel's Textbook of Inorganic Quantitative Analysis"
   By G. Svehla 7TH Edition 2012
2. "A Textbook of Practical Inorganic Chemistry"
   By A.I. Vogel, B. Sivasankar (adapted edition)
3. "Practical Inorganic Chemistry"
   By G. Pass and H. Sutcliffe 1974
4. " Experimental Inorganic Chemistry"
   By W. G. Palmer 1962"Selected Experiments in Inorganic Chemistry"
   By W. L. Jolly
5. "Advanced Practical Inorganic Chemistry"
   By Gurdeep 2020
6. "Laboratory Manual in Inorganic Chemistry"

By R. Gopalan, Venkappayya, Nagarajan

7. "College Practical Chemistry" (Inorganic Section) *By Ahluwalia, Bhagat, and Ramesh, 2005.*
8. Practical Inorganic Chemistry Shikha Gulati, J.L. Sharma, Shagun Manocha Edition: 2019.
9. Advanced Practical Inorganic Chemistry Gurdeep Raj, 19th Edition, 2007

Organic chemistry practical

1. Practical Organic Chemistry – A. I. Vogel
2. Practical Organic Chemistry – H. Middleton.
3. Practical Organic Chemistry – O. P. Aggarwal

Course Code	Course Title	Credits	Lectures/ Week
25CHEEL611	**DRUGS (T) ELECTIVE**	**2**	**2**

Course Outcomes:

CO1: To know the definitions of various types of Chemotherapeutic and Pharmacodyanamic drugs

CO2 : To understand general concepts of various types of drugs and Drug intermediates.

CO3 : To study the applications of various types of drugs for different types of diseases.

CO4 : To analyse the structures, chemical classes, uses and side effects of various drugs.

Unit	Topics	No of Lectures
I	**Pharmacodynamic agents:** A brief introduction of the following pharmacodynamic agents and the study with respect to their chemical structure, chemical class, therapeutic uses, and side effects. **1. CNS Drugs:** Classification based on pharmacological actions: CNS Depressants & CNS Stimulants. Concept of sedation and hypnosis, anaesthesia. ● Phenytoin (Hydantoin)	**15**

	● Trimethadione (Oxazolidinediones) (**Synthesis from acetone)** ● Alprazolam (Benzodiazepines) ● Levetiracetam (Pyrrolidines) ● Amphetamine (Phenethylamine) (**Asymmetric synthesis from phenyl acetic acid)** ● Chlorpromazine (Phenothiazines) **2. Analgesics, Antipyretics and Anti-inflammatory Drugs.** **2.1. Analgesics and Antipyretics** ● Morphine (Phenanthrene alkaloids) ● Tramadol (Cyclohexanols) (**Synthesis from salicylic acid)** ● Aspirin (Salicylates) ● Paracetamol (p-Amino phenols) 2.2 **Anti-inflammatory Drugs** 2.2.1 Mechanism of inflammation and various inflammatory conditions 2.2.2Steroidal Anti-inflammatory Drugs : Prednisolone, Betamethasone 2.2.3 Non-steroidal Anti-inflammatory Drugs: Sodium Diclofenac, Aceclofenac (N- Aryl anthranilic acids) **(Synthesis from 2,6-dichlorodiphenyl amine)** **3. Antihistaminic Drugs** ● Diphenhydramine (Ethanol amines) ● Cetirizine (Piperazine) (Synthesis from 4-Chlorobenzhydryl chloride) ●Chlorpheniramine maleate (Ethyl amines) ● Pantoprazole (Benzimidazoles) **4. Cardiovascular drugs** Classification based on pharmacological action ● Isosorbide dinitrate (Nitrates) ● Valsartan (Amino acids) (structure not expected)	

	● Atenolol (Aryloxy propanol amines) (Synthesis from 3-Hydroxy phenyl acetamide) ● Amlodipine (Pyridines) ● Frusemide /Furosemide (Sulfamoyl benzoic acid) ● Rosuvastatin (Pyrimi**dine)** **5. Antidiabetic Agents** General idea and types of diabetes; Insulin therapy ● Glibenclamide (Sulphonyl ureas) ● Metformin (Biguanides) ● Dapagliflozin (Pyranose) ● Pioglitazone (Thiazolidinediones) (Synthesis from 2-(5-ethylpyridin-2-yl) ethanol)	
II	**Chemotherapeutic Agents:** Study of the following chemotherapeutic agents with respect to their chemical structure, chemical class, therapeutic uses, side effects and introduction to MDR wherever applicable. **1. Antibiotics and antiviral** ● Definition, ● Amoxicillin (b- lactum antibiotics) ● Cefpodoxime (Cephalosporins) ● Doxycycline (Tetracyclines) ●Levofloxacin (Quinolones) (**Synthesis from 2,3,4 – Trifluro -1- nitrobenzene)** ● Aciclovir/Acyclovir (Purines) **2. Antimalarials** Types of malaria**,** Symptoms of malaria**,** Pathological detection during window period (Life cycle of the parasites not to be discussed) ● Chloroquine (3-Amino quinolones)	**15**

	● Artemether(Benzodioxepins) Following combination to be discussed: ● Atremether + Lumefantrine (no structures expected) **3. Anthelmintics and AntiFungal agents** Drugs effective in the treatment of Nematodes and Cestodes infestations. ● Diethyl carbamazine (DEC) (Piperazines) ● Albendazole (Benzimidazoles) (**Synthesis from 2-Nitroaniline)** ● Clotrimazole (Imidazole) ● Fluconazole (Triazole) **4. Antiamebic Drugs** ● Types of Amebiasis ● Structures, chemical class, uses and side effects of Metronidazole, Ornidazole, Tinidazole (Imidazole) Synthesis of Metronidazole from glyoxal by Debus-Radziszewski imidazole synthesis route. **Following combination therapy to be discussed:** Ciprofloxacin +Tinidazole **5. Antitubercular and Antileprotic Drugs** ●Types of Tuberculosis; Symptoms and diagnosis of Tuberculosis. Types of Leprosy. General idea of Antibiotics used in their treatment. ● PAS (Amino salicylates) ● Isoniazide (Hydrazides) ● Pyrazinamide (Pyrazines) ● (+) Ethambutol (Aliphatic diamines (**Synthesis from 1-Nitropropane)** ● Dapsone(Sulphonamides) (**Synthesis from 4-Chloronitrobenzene)** ● Clofazimine (Phenazines) ● Bedaquiline (Quinoline)	

	Following combination therapies to be discussed: (i) Rifampin + Ethambutol + Pyrazinamide (ii) Rifampin + Isoniazide + Pyrazinamide **6. Anti-Neoplastic Drugs** Idea of malignancy; Causes of cancer, Brief idea of Immuno Stimulants & Immuno depressants ● Lomoustine (Nitrosoureas) ● Anastrozole(Triazoles) (**Synthesis from 3,5-bis (bromo methyl) toluene)** ● Cisplatin (Chloro Platinum) ● Vincristine, Vinblastine, Vindesine) (Vinca alkaloids) (structure not expected) **7. Anti-HIV Drugs** Idea of HIV pathogenicity, Symptoms of AIDS ● AZT/Zidovudine ● Lamivudine ●DDI (Purines) **8. Drug Intermediates:** Synthesis and uses of - (a) 2,3,6-Triamino-6- hydroxypyrimidine from Guanidine (b) p-[2'-(5-Chloro-2-methoxy benzamido) ethyl]-benzenesulphonamide from Methyl-5-chloro-2-methoxybenzene (c) 3-(p-Chlorophenyl)-3-hydroxypiperidine from 3-Chloroaceto - phenone (d) p-Acetyl amino benzenesulphonyl chloride from Aniline (e) Epichlorohydrine from propene.	

References:

Unit I

1. Foye's principles of medicinal chemistry. 6th Edition, Edited by Davis William & Thomas Lemke, Indian edition by B I Publication Pvt Ltd, Lippmcolt Williams & Wilkins.

2. Text book of organic medicinal & pharmaceutical chemistry. Wilson &Gisovolds, 11th Edition by John H Block, John M Beale Jr.

3. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.

4. Burger's Medicinal Chemistry, Drug Discovery and Development. Abraham and Rotella. Wiley

5. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.

6.Medicinal chemistry. V.K. Ahluwalia and Madhu Chopra, CRC Press.

7. Principle of medicinal chemistry. Vol 1 &2 S. S. Kadam, K. R. Mahadik, K. G. Bothara

8. The Art of Drug synthesis. Johnson and Li. Wiley, 2007.

9 The organic chemistry of drug design & drug action. 2nd ed. By Richard B Silvermann, Academic Press.

10. The Organic Chemistry of Drug Synthesis. Lednicer and Mitsher, Wliey.

Unit II

1. Foye's principles of medicinal chemistry. 6th Edition, Edited by Davis William & Thomas Lemke, Indian edition by B I Publication Pvt Ltd, Lippmcolt Williams & Wilkins.

2. Text book of organic medicinal & pharmaceutical chemistry. Wilson &Gisovolds, 11th Edition by John H Block, John M Beale Jr.

3. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.

4. Burger's Medicinal Chemistry, Drug Discovery & Development. Abraham & Rotella. Wiley

5. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.

6. Medicinal chemistry. V.K. Ahluwalia and Madhu Chopra, CRC Press.

7. Principle of medicinal chemistry. Vol 1 & 2 S. S. Kadam, K. R. Mahadik, K. G. Bothara

8. The Art of Drug synthesis. Johnson and Li. Wiley, 2007.

9. The organic chemistry of drug design & drug action. 2nd ed. By Richard B Silvermann, Academic Press.

10.The Organic Chemistry of Drug Synthesis. Lednicer and Mitsher, Wliey.

11.Text book of drug design and discovery. Povl-Krog-Sgaard-Larsen, Tommy Liljefors and ULF Madsen, 3rd Edition Taylor & Francis.

12. Bio-applications of nanoparticles. Edited by Warren C.W. Chan, Springer Publication.

13. Nanoparticle and technology for drug delivery (Drugs and pharmaceutical sciences). Ram B.Gupta& Uday B.Kompella Pub. Informa Healthcare.

14. Nano forms of carbon and its applications. Edited by Maheshwar Sharon and Madhuri Sharon.MonadNanotechPvt. Ltd.

15. Environmental Chemistry. A. K. De

16. Text Book on Law and Medicine. Chokhani and Ghormade. 2nd Edition. Hind Law House,Pune.

17. Essentials of Medical Pharmacology. K D Tripathi, Jaypee Brothers Medical publishers Pvt. ltd. Practical organic chemistry, Vogel.

Course Code	Course Title	Credits	Lectures/ Week
25CHEEL61P	**DRUGS PRACTICAL (ELECTIVE PRACTICAL COURSE)**	**2**	**4**

Course Outcomes:

Unit	Topics
1	Preparation of aspirin from salicylic acid (Acetylation)
2	Preparation of acetanilide from aniline (Acetylation)
3	Preparation of p-nitroacetanilide from acetanilide (Nitration)
4	Preparation of p-nitroaniline from p-nitroacetanilide (Hydrolysis)
5	Preparation of paracetamol from p-aminophenol (Acetylation)
6	Preparation of nerolin from β--naphthol (O-methylation)
7	Preparation of methyl salicylate from salicylic acid (Esterification)
8	Estimation of iodine in tincture iodine solution
9	Estimation of Ibuprofen
10	Estimation of acid neutralising capacity of an antacid

11	Estimation of free acid in vegetable oil (castor oil/olive oil/coconut oil/ groundnut oil)
12	Estimation of vitamin C
13	Preparation of Monogram of any one drug from the syllabus by IP method

References:

Unit I

1. Foye's principles of medicinal chemistry. 6th Edition, Edited by Davis William & Thomas Lemke, Indian edition by B I Publication Pvt Ltd, Lippmcolt Williams & Wilkins.
2. Text book of organic medicinal & pharmaceutical chemistry. Wilson &Gisovolds, 11th Edition by John H Block, John M Beale Jr.
3. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
4. Burger's Medicinal Chemistry, Drug Discovery & Development. Abraham & Rotella. Wiley
5. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
6. Medicinal chemistry. V.K. Ahluwalia and Madhu Chopra, CRC Press.
7. Principle of medicinal chemistry. Vol 1 & 2 S. S. Kadam, K. R. Mahadik, K. G. Bothara
8. The Art of Drug synthesis. Johnson and Li. Wiley, 2007.
9. The organic chemistry of drug design & drug action. 2nd ed. By Richard B Silvermann, Academic Press.
10. The Organic Chemistry of Drug Synthesis. Lednicer and Mitsher, Wliey.
11. Text book of drug design and discovery. Povl-Krog-Sgaard-Larsen, Tommy Liljefors and ULF Madsen, 3rd Edition Taylor & Francis.
12. Bio-applications of nanoparticles. Edited by Warren C.W. Chan, Springer Publication.

Course Code	Course Title	Credits	Lectures /Week
25CHEEL612	**Heavy & Fine Chemicals – II ELT-2**	**4**	**4**

Course Outcomes:

CO1: Understand the fundamentals of refrigeration systems and identify various cold transfer media, including their industrial applications.

CO2: Explain different sources of energy, the generation and treatment of boiler feed water,

and interpret properties of steam using the steam table.

Explain the structure and applications of zeolites, clays, and ion-exchange resins in chemical processes.

Understand the production methods and uses of industrial gases like hydrogen and acetylene.

Explain the preparation methods and uses of inorganic fine chemicals such as potassium permanganate and ferrous sulfate heptahydrate. Explain the manufacturing processes and types of soaps, including raw materials and continuous processes.

Understand the classification, structure, synthesis, and application of dyes such as Indigo, Alizarin, and Congo red.

CO3: Demonstrate knowledge of glass types, composition, and applications across various industries.

Classify chemical reactors and pressure vessels, explain their design requirements, maintenance, and application in storage of industrial liquids and gases.

Classify and analyze the properties of oils and fats, and describe their extraction and processing techniques.

CO4: Describe the manufacturing processes, properties, and industrial uses of sulfuric acid, ammonia, and sodium hydroxide.

Unit	Topics	No of Lectures
I	1.1 Refrigeration: System, media used for cold transfer (i.e. brine and other) 3L 1.2 Different Sources of Energy: Generation, Treatment of boiler feed water, Properties of steam, steam table 3L a) Glass: Composition, types and applications. 3L 1.3Manufacturing process properties and applications of: 6L a) Sulphuric acid (Contact Process) b) Ammonia (Haber's process) c) Sodium hydroxide	**15**
II	2.1 Zeolites, Clays and Ion-exchange resins 3L 2.2 Design of vessel: Classification of chemical reactors, pressure vessels for internal or external pressure, Maintenance, storage vessels for liquids and gases . 4L 2.2 Manufacture and uses of Industrial gases: Hydrogen and Acetylene 2L 2.3 Industrial preparation of Inorganic Fine chemicals: KMnO4, FeSO4.7H2O 2L 2.5 Composite materials: Introduction, Constitution of composites, Classification of composites, Particle Reinforced composites, Fiber reinforced composites, Structural composites or Layered composites, Applications of composite materials. 4L	**15**

III	3.1 Small Scale Industries and R and D technology:Need and scope of small scale industry, SSI rules and regulations, R and D, technology transfer, Role of R and D, Functional structure of R and D unit, Research strategies and manufacturing interface, University- Indus try interface, Patents 7L 3.2 Manufacture of soaps: Raw materials, Preparation, properties and types of soaps, Continuous process for the manufacture of soap. 2L 3.3 Oils and Fats: Introduction, Classification, Properties of oils and fats, extraction of oils from oil seeds, hydraulic pressing and solvent extraction, extraction of animal fats, hardening of oils 4L 3.4 Detergents: Introduction, classification, manufacture of DDBS, industrial applications 2L	**15**
IV	4.1 Unit Operations; General idea of the following operations used in Industries; 9L 1) Filtration: Introduction, factors affecting the rate of Filtration, Filtration processes a) Plate and frame filter Press b) Rotary Drum filter 2)Distillation: Introduction, Distillation methods a) Bubble cap column distillation b) Fractional distillation 3) Crystallization: Introduction, Solubility, Super saturation, Nucleation, Crystal growth, Crystallization process, a) Agitated Tank Crystallizer, b) Swenson Walker Crystallizer 4) Centrifugation: Introduction, Centrifugation process used in Industry. 4.2: Introduction to Dyes: Dye, Chromophores (with examples), Auxochromes (with examples), Synthesis and uses of the following dyes: 1) Indigo 2) Alizarin 3) Eriochrome Black-T 4) Auramine-O 5) Procion-red 6) Congo red 6L	**15**

Reference:

Unit I and II

1. C. D. Dryden: Outlines of Chemical Technology, edited & revised by M. Gopala Rao & Marshall Sittig East West Press, New Delhi.
2. Faith Keyes and Clerk's Industrial Chemicals, 4th Edn., Wiley Inter-science 1975.
3. Foust A. S. et-al.: Principles of Unit Operations John Wiley & Sons.
4. Macabe W.L., Smith J. C. and Harriott. P. Unit Operations of Chemical Engineering (7th edition) (McGraw Hill Chemical Engineering series).
5. P. H. Groggins: Unit Processes in Organic Synthesis, McGraw Hill.
6. Kirk & Othmer: Encyclopeadia of Chemical Technology, John Wiley and sons.
7. A. I. Vogel: Text book of Quantitative Analysis including Instrumental Analysis.
8. A. I. Vogel: Text book of Quantitative Organic Analysis.
9. Industrial Inorganic Chemistry-Buchner, Schliebs, Winter, translated by D. H. Tenell, VCH Publishers, New York.
10. Industrial Organic Chemistry- K. Welssermel, H. J. Arpe, VCH Publishers, New York.
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14. The Chemistry of Synthetic Dyes – Edited by K. Venkatraman. Academic press Inc. London.
15. Shreeves 'Chemical Process Industries' 5th Edition, G. T. Oustin, McGraw Hill.
16. Industrial Chemistry- B. K. Sharma, Goyal publishing house, Mirut.
17. Riegel's Hand Book of Industral Chemistry, 9th Edition, Jems A. Kent.
18. Industrial Chemistry- E Stoch, Vol- I, Ellis Horwood Ltd. UK.
19. An Introduction to Industrial Organic Chemistry- Wiseman and Peter, ""
20. Unit Operations and Processes- P. H. Groggins.
21. Unit Operations I and II- P.P. Kale- Pune Vidyarthigruh Prakashan.
22. Unit Operations in Chemical Engineering by W. L. McCabe and Smith.
23. Riegel's Handbook of Industrial Chemistry, J. A. Kent, CBS Publishers, New Delhi
24. Riegel's Handbook of Industrial Chemistry, James A. Kent, 7th Edition, Van Nostrand Reinhold Company.
25. Shreeves 'Chemical Process Industries' 5th Edition, G. T. Austin, McGraw Hill, 1984.

Course Code	Course Title	Credits	Lectures/ Week
25CHEMN621	**Chemistry Minor Theory**	**2**	**2**

Course Outcomes:

CO1:

- Understand the basic concept of electrochemistry and applied electrochemistry. Remember the definitions and types of polymers, catalysts and reagents.
- To know metallurgy and its types, electronic configuration and basic properties of group 18 elements,

CO2:

- Illustrate and compare various types of chemical cells. To understand the reactions of polymerization and its utilities.
- To understand basic steps involved in the process of metallurgy

CO3:

- Apply the knowledge of electrochemistry and applied electrochemistry. Apply the knowledge of basic chemistry to know the applicational chemistry of polymers.
- To apply basic steps involved in metallurgy for extraction of copper.

CO4:

- Analyze given sample using electrochemistry.
- To use the knowledge gained to analyze the monomers of a polymer given.
- Analyze the structures of compounds of xenon (oxides and fluorides) based on VSEPR.

Unit	Topics	No of Lectures
I	**ELECTROCHEMISTRY (10L)** 1.1 Activity and Activity Coefficient: Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. Debye- Huckel limiting law (No derivation) .1.2 Classification of cells: Chemical cells and Concentration cells. Chemical cells with and without transference, Electrode Concentration cells, Electrolyte concentration cells with and without transference (derivations are expected), 1.3 APPLIED ELECTROCHEMISTRY : Polarization: concentration polarization and it‟s elimination. Decomposition Potential and Overvoltage : Introduction, experimental determination of decomposition potential, factors affecting decomposition potential. Tafel‟s equation for hydrogen overvoltage, experimental determination of over – voltage **Metallurgy(05)** Types of metallurgies, General steps of metallurgy; Concentration of ore, calcinations, roasting, reduction and refining. Metallurgy of copper: occurrence, physicochemical principles, Extraction of copper from pyrites & refining by electrolysis.	15
II	**Chemistry of Group 18 (05L)** Historical perspectives, General characteristics and trends in physical and chemical properties, Isolation of noble gases, Compounds of Xenon (oxides and fluorides) with respect to preparation and structure (VSEPR) **Polymer (10L)** **Introduction:** terms monomer, polymer, homopolymer, copolymer, thermoplastics and thermosets. **Addition polymers:** polyethylene, polypropylene, teflon, polystyrene, PVC, Uses. **Condensation polymers:** polyesters, polyamides, polyurethanes, polycarbonates, phenol formaldehyde resins.Uses	15

	Natural and synthetic rubbers: Polymerisation of isoprene: 1,2 and 1,4 addition (cis and trans), Styrene butadiene copolymer. **Additives to polymers:** Plasticisers, stabilizers and fillers. **Biodegradable polymers:** Classification and uses. polylactic acid structure, properties and use for packaging and medical purposes. (Note: Identification of monomer in a given polymer & structure of polymer for a given monomer is expected. condition for polymerization is not expected)	

References:

Physical chemistry:

1. Electrochemistry, Author: P. Atkins and Julio de Paula
2. Electrochemistry, Author: B. P. Levich
3. An Introduction to Electrochemistry, Author: Samuel Glasstone
4. Fundamentals of Electrochemistry, Authors: Vladimir S. Bagotsky
5. Electrochemical Methods: Fundamentals and Applications, Authors: Allen J. Bard & Larry R. Faulkner

Inorganic Chemistry

1. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
2. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
3. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
4. Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi.
5. R.Gopalan, Chemistry for undergraduates. Chapter 18. Principles of Metallurgy.(567-591)
6. Puri ,Sharma Kalia Inorganic chemistry. Chapter 10, Metals and metallurgy.(328-339)

Organic Chemistry:

1. Polymer chemistry by M.G.Arora, K.Singh.
2. Polymer science – a textbook by Ahluwalia and Mishra
3. Introduction to polymer chemistry - R.Seymour, Wiley Interscience.
4. Organic chemistry by Francis Carey – McGrawHill .

Course Code	Course Title	Credits	Lectures/ Week
25CHEMN62P	**Chemistry Minor Practical**	**2**	**4**

Course Outcomes: After successful completion of the course, the learner will be able to;

CO1: Understand the basic concept of electrochemistry and polymer chemistry. To recall organic separation techniques.

CO2: Illustrate and compare various types of chemical cells. To understand the chemistry behind the chemical type of mixture.

CO3: Apply the knowledge of electrochemistry and polymer chemistry. To apply theoretical knowledge to separate solid-liquid and liquid-liquid mixture of organic compounds.

CO4: Analyze given sample using electrochemistry and polymer chemistry. Analyze and identify organic compounds after separation.

Unit	Topics
1	To determine the amount of chloride, bromide and iodide in the mixture by potentiometric titration.
2	To determine the number of electrons in the redox reaction between ferrous ammonium sulphate and ceric sulphate potentiometrically.
3	To determine the molecular weight of PVA by viscometry method.
4	To determine the molecular weight of polyethylene glycol by viscometry method.
5	To determine the amount of acetic acid in the given mixture by using quinhydrone electrodes potentiometrically.
6	To prepare Tris(acetylacetonato)iron(III).
7	To prepare Bis(dimethylglyoximato)nickel(II) complex using nickel carbonate and dmg by green synthesis.

8	To determine the percentage purity of PbNO3 complexometrically from the binary mixture and detection of cation and anion of the impurity salt.
9	To determine the percentage purity of MgSO4.7H2O complexometrically from the binary mixture and detection of cation and anion of the impurity salt.
10	To determine the percentage purity of CaCl2.2H2O complexometrically from the binary mixture and detection of cation and anion of the impurity salt.
11	Separation of Binary solid-liquid and liquid-liquid mixture (6-10 ml mixture to be given). Minimum five mixtures to be completed by the students. Components of the mixture should include volatile liquids, non-volatile liquids and solid soluble in volatile liquids.

References:

Physical chemistry practical

1. Laboratory Manual of Physical Chemistry, Author: S.H. Maron & C.F. Prutton
2. Experiments in Physical Chemistry, Authors: Shoemaker, Garland & Nibler
3. Advanced Practical Physical Chemistry, Author: J.B. Yadav Publisher: Goel Publishing House
4. Practical Physical Chemistry, Author: B. Viswanathan & P.S. Raghavan, Publisher: Viva Books
5. Comprehensive Practical Physical Chemistry, Authors: V.K. Ahluwalia & Sunita Dhingra

Inorganic Chemistry:

1. Vogel's Textbook of Inorganic Quantitative Analysis"
   By G. Svehla 7TH Edition 2012
2. "A Textbook of Practical Inorganic Chemistry"
   By A.I. Vogel, B. Sivasankar (adapted edition)
3. "Practical Inorganic Chemistry"
   By G. Pass and H. Sutcliffe 1974
4. " Experimental Inorganic Chemistry"
   By W. G. Palmer 1962"Selected Experiments in Inorganic Chemistry"
   By W. L. Jolly
5. "Advanced Practical Inorganic Chemistry"
   By Gurdeep 2020
6. "Laboratory Manual in Inorganic Chemistry"
   By R. Gopalan, Venkappayya, Nagarajan
7. "College Practical Chemistry" (Inorganic Section)
   By Ahluwalia, Bhagat, and Ramesh, 2005.

8. Practical Inorganic Chemistry Shikha Gulati, J.L. Sharma, Shagun Manocha Edition: 2019.
9. Advanced Practical Inorganic Chemistry Gurdeep Raj, 19th Edition, 2007

Organic chemistry:

1. Practical Organic Chemistry – A. I. Vogel
2. Practical Organic Chemistry – H. Middleton.
3. Practical Organic Chemistry – O. P. Aggarwal

Course Code	Course Title	Credits	Lectures/ Week
25CHEOJT61	**ON JOB TRAINING**	**4**	**8**

learning outcomes:

1. Develop or sharpen their skills and gain real-time experience and knowledge with professionals in their field of interest.
2. Explore career alternatives prior to graduation.
3. Develop work habits and attitudes necessary for job success
4. Acquire professional contacts leading directly to a full-time job/research opportunity following graduation from college.
5. Enhance Job Potential/ Develop Research Aptitude
6. Design and present a report summarizing their on-the-job training experience.
7. Students will compile, organize, and present a comprehensive project report or presentation outlining their OJT outcomes.

	On-Job Training (OJT) opportunities for undergraduate chemistry students, each designed for approximately for 120 hours (about 3–4 weeks full-time) across different fields as per the guidelines suggested by the college authorities. These can be conducted in industry, research labs, or institutions, etc. depending upon the availability.

Evaluation Scheme for Third 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 Hour

Theory question paper pattern:

Question	Based on	Marks
Q.1	Unit I	15
Q.2	Unit II	15

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be subdivided 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: 4 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 Pattern for field project and on Job Training:

Sr. No	TYBSC	Nature of work	Logbook and Certificate	Work Presentation	Viva Voce	Total Marks
1	Semester 5	Field Project	20	20	10	50
2	Semester 6	On Job Training	40	40	20	100

Evaluation Scheme for Third Year (UG) under NEP (4 credits)

I. Internal Evaluation for Theory Courses – 40 Marks

1) Continuous Internal Assessment(CIA) Assignment - Tutorial/ Case Study/ Project / Presentations/ Group Discussion / Ind. Visit. – 20 marks

2) Continuous Internal Assessment(CIA) ONLINE Unit Test – 20 marks

II. External Examination for Theory Courses – 60 Marks

Duration: 1 Hour

Theory question paper pattern:

Question	**Based on**	**Marks**
Q.1	Unit I	15
Q.2	Unit II	15
Q.3	Unit III	15
Q.4	Unit IV	15

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