FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

Department of CHEMISTRY

Course Curriculum

FOUR YEAR UNDERGRADUATE PROGRAM (NEP–2020)

Program: Bachelor in Science

DISCIPLINE–CHEMISTRY

Session–2024-28

DSC- 01 to 08		DSE-01 to 12		DGE-01 to 06	
Code	Title	Code	Title	Code	Title
CHSC-01T	Fundamental Chemistry-I	CHSE-01T	Basic Analytical Chemistry	CHGE-01T	Fundamental Chemistry-I
CHSC-01P	Chemistry Lab. Course-I	CHSE-01P	Basic Analytical Chemistry Lab. Course	CHGE-01P	Chemistry Lab. Course-I
CHSC-02T	Fundamental Chemistry-II	CHSE-02T	Environmental Chemistry	CHGE-02T	Fundamental Chemistry-II
CHSC-02P	Chemistry Lab. Course-II	CHSE-02P	Environmental Chemistry Lab. Course	CHGE-02P	Chemistry Lab. Course-II
CHSC-03T	Inorganic and Physical Chemistry-I	CHSE-03T	Dyes & Polymer Chemistry		
CHSC-03P	Chemistry Lab. Course-III	CHSE-03P	Dyes & Polymer Chemistry Lab. Course		
CHSC-04T	Organic and Physical Chemistry-I	CHSE-04T	Heterocyclic Chemistry		
CHSC-04P	Chemistry Lab. Course-IV	CHSE-04P	Heterocyclic Chemistry Lab. Course		
CHSC-05T	Organic & Inorganic-I	CHSE-05T	Photochemistry & Pericyclic Reactions		
CHSC-05P	Chemistry Lab. Course-V	CHSE-05P	Photochemistry & Pericyclic Reactions Lab. Course		
CHSC-06T	Organic and Physical Chemistry-II	CHSE-06T	Spectroscopy-I		
CHSC-06P	Chemistry Lab. Course-VI	CHSE-06P	Spectroscopy-I Lab. Course		
CHSC-07T	Inorganic & Physical Chemistry-II	CHSE-07T	Chemical Kinetics & Nuclear Chemistry		
CHSC-07P	Chemistry Lab. Course-VII	CHSE-07P	Chemical Kinetics & Nuclear Chemistry Lab. Course		
CHSC-08T	Organic & Inorganic-II	CHSE-08T	Electrochemistry & Surface Chemistry		
CHSC-08P	Chemistry Lab. Course-VIII	CHSE-08P	Electrochemistry & Surface Chemistry Lab. Course		
		CHSE-09T	Spectroscopy-II		
		CHSE-09P	Spectroscopy-II Lab. Course		
		CHSE-10T	Nanotechnology & Solid State	SEC	
		CHSE-10P (VIII SEM)	Nanotechnology & Solid State Lab. Course		
		CHSE-11T	Medicinal Chemistry & Natural Products	CHSEC-01T&P	Chemical Analysis Techniques
		CHSE-11P	Medicinal Chemistry & Natural Products Lab. Course		
		CHSE-12T	Instrumental Methods of Analysis	VAC	
		CHSE-12P	Instrumental Methods of Analysis Lab. Course	CHVAC-01T	Chemistry in Daily Life

1 2 3 4 5

6 7 8 9 10

FOUR YEAR UNDERGRADUATE PROGRAM(NEP–2020)

Program: Bachelor in Science

DISCIPLINE–CHEMISTRY

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PO & PSO

PROGRAMME OUTCOMES (PO)

PO-1: B.Sc. Chemistry curriculum is so designed to provide the students a comprehensive understanding about the fundamentals of chemistry covering all the principles and perspectives.

PO-2: The branches of Chemistry such as Organic Chemistry, Inorganic Chemistry, Physical Chemistry and Analytical Chemistry expose the diversified aspects of chemistry where the students experience a broader outlook of the subject.

PO-3: The syllabi of the B.Sc. Chemistry course are discretely classified to give stepwise advancement of the subject knowledge right through the four years of the term.

PO-4: The practical exercises done in the laboratories impart the students the knowledge about various chemical reagents and reactions. They are also trained about the adverse effects of the obnoxious chemicals and the first aid treatment.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO-1: The students will understand the existence of matter in the universe as solids, liquids, and gases which are composed of molecules, atoms and sub atomic particles.

PSO-2: Students will learn to estimate inorganic salt mixtures and organic compounds both qualitatively and quantitatively using the classical methods of analysis in practical classes.

PSO-3: Students will grasp the mechanisms of different types of reactions both organic and inorganic and will try to predict the products of unknown reactions.

PSO-4: Students will learn to synthesize the chemical compounds by maneuvering the addition of reagents under optimum reaction conditions

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester - I**	Session: **2024-2025**
1	**Course Code**	**CHSC-01T**		
2	**Course Title**	**FUNDAMENTAL CHEMISTRY-I**		
3	**Course Type**	**DSC**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***To know the contributions of ancient Indian scientists, study atomic structure, and periodic properties.*** ➢ ***To explore the concept of chemical bonding, including ionic and covalent bonding, hybridization, molecular orbital theory and intermolecular interactions.*** ➢ ***To learn about reaction mechanisms of inorganic reactions and their stoichiometry.*** ➢ ***To understand basics principles of organic chemistry.***		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**A. Chemistry in Ancient India:** (a) Chemical techniques in ancient India: General Introduction (b) Contribution of ancient Indian scientists in chemistry, e.g., metallurgy, dyes, pigments, cosmetics, Ayurveda, Charak Sanhita. **Ancient Indian Chemist**- Their Contribution and Books- Rishi Kanad, Aacharya Nagarjuna, Vagbhatta, Govindacharya, Yashodhar, Ramchandra, Somadava, Gopalbhatta etc. Indian Chemist of 19th century- Aacharya Prafulla Chandra Ray- His Contribution and work for Indian Chemistry. **B. Atomic Structure and Periodic Properties:** (i) Review of Bohr's theory and its limitations. Dual nature of particles and waves, de Broglie's equation, Heisenberg's Uncertainty principle and its significance. (ii) Quantum numbers and their significance. Rules for filling electrons in various orbitals, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals. Anomalous electronic configurations. (iii)Effective nuclear charge (ENC), shielding or screening effect, Slater rules, Atomic and Ionic radii. Ionization energy and factors affecting ionization energy. Electron affinity, Electronegativity—Pauling's/Mulliken's electronegativity scales. Relation of electronegativity with hybridization.	11
II	**Chemical Bonding – I A) Ionic Bonding:** General characteristics of ionic bonding. **Ionic Bonding & Energy:** Lattice and solvation energies and their importance in the context of stability and solubility of ionic compounds. **Born-Haber Cycle and its Applications:** Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules. **B) Covalent Bonding:** Lewis structures, Valence Bond theory, Hybridization (concept and types with suitable examples), dipole moment and percentage ionic character. Valence shell electron pair repulsion theory (VSEPR) and structure of NH_3, H_2O, SF_4, ClF_3, PCl_5, SF_6, XeF_2, XeF_6, XeO_3, $XeOF_4$, XeF_4.	12

	Chemical Bonding - II **A) MO theory:** LCAO method-criteria of orbital overlapping, types of molecular orbitals-σ-, π- and, δ-MOs; formation of σ- and π-MOs and their, schematic illustration; qualitative MO energy level diagram of homo- (N_2 & O_2(including peroxide, superoxide)) and hetero-diatomic molecules (NO, CO), magnetic properties, bond order and stability of molecules and ions. **B)** Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, ion-induced dipole interactions, dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment).	
III	**A. Chemical properties of s-block metals** Reaction with water, air, and nitrogen, Anomalous behavior of Li and Be, Compounds of s-block metals: Oxides, hydroxides, peroxides, and superoxides (preparation and properties) Complexes of s-block metals, Complexes with crown ethers **B. Chemistry of p-Block Elements** **Boron group:** Hydrides (classification of boranes), Diborane (preparation, properties, and structure elucidation), Borazine (preparation and structure) **Carbon group:** Carbides (salt-like carbides, interstitial carbides, covalent carbides), Silicates (classification, three-dimensional silicates - properties and structures) **Nitrogen group:** Hydrides of Nitrogen (hydrazine, hydroxylamine, hydrazoic acid) Structure of oxides of nitrogen (N_2O, NO, NO_2, N_2O_4, and N_2O_5), Structure of oxyacids of nitrogen (HNO_2, HNO_3, $H_2N_2O_7$,), Nitrides (classification, preparation, properties, and uses) Structure of Oxides and oxoacids of phosphorus: (P_2O_3, P_2O_5) H_3PO_2, H_3PO_3, H_3PO_4, $H_4P_2O_7$ **Halogen:** Hydrides, Oxides and oxyacids of halogens (structure only) – Inter halogen compounds and pseudo halogens	**11**
IV	**Electronic Effects in Organic Compounds** Bond Cleavage: Homolytic and heterolytic cleavages, bond energy, bond length, and bond angle. Electron Displacement Effects: Inductive, inductomeric, electromeric, mesomeric (resonance), hyperconjugation, and steric effects. Tautomerism (keto-enol, amido-imidol, and nitro-acinitro forms). Reaction Intermediates: Formation and stability of carbocations, carbanions, free radicals, carbenes, nitrene and benzyne. **B. Stereochemistry of Organic Compounds** **i) Optical Isomerism** Elements of symmetry, chirality, enantiomers, and optical activity, Chiral and achiral molecules with two stereogenic centers (Tartaric acid as an example),Erythro & Threo, Diastereomers and meso compounds, Inversion, retention, and racemization, Relative configuration (D/L), and absolute configuration (R/S nomenclature: sequence rules). **ii) Geometrical Isomerism** Geometric isomerism (cis-trans isomerism) in alkenes with examples (maleic acid, fumaric acid, and 2-butene), E/Z system of nomenclature.	**11**
Keywords	***Ancient Indian Chemistry, Atomic Structure, Periodic Properties, Chemical Bonding, s- &p-block elements, Electronic effects, Stereochemistry***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –
Text Books

1. Puri, B. R., Sharma, L. R., & Kalia, K. C. (2018). *Principles of Inorganic Chemistry*. Nagin Chand and Co., New Delhi.
2. Satyaprakash, G., Tuli, S. K., Basu, S. K., & Madan, R. D. (2017). *Advanced Inorganic Chemistry* (Vol. 1, 5th Ed.). S. Chand & Company.
3. Lee, J. D. (2010). *Concise Inorganic Chemistry* (5th Ed.). Blackwell Science.
4. Housecroft, C. E., & Sharpe, A. G. (2012). *Inorganic Chemistry* (4th Ed.). Pearson Education Limited.
5. Ray, Acharya Prafulla Charndra, ***History of Chemistry in Ancient And Medieval India***, Chowkhamba Krishnadas Academy (Reprint 2004).

Reference Books

1. Cotton, F. A., Wilkinson, G., & Gaus, P. L. (2002). *Basic Inorganic Chemistry* (3rd Ed.). John Wiley & Sons.
2. Douglas, B. E., Mcdaniel, D. T., & Alexander, J. J. (1994). *Concepts and Models Of Inorganic Chemistry* (3rd Ed.). John Wiley & Sons.
3. Huheey, J. E., Keiter, E. A., & Keiter, R. L. (1993). *Inorganic Chemistry* (4th Ed.). Harpercollins College Publishers.
4. Shriver, D. F., Atkins, P. W., & Langford, C. H. (2010). *Inorganic Chemistry* (5th Ed.). W. H. Freeman And Company.
5. Moeller, T. (1990). *Inorganic Chemistry: A Modern Introduction*. Wiley.

Online Resources–

- https://bit.ly/3AyV3mZ
- https://nptel.ac.in/courses/104/104/104104101/
- https://nptel.ac.in/courses/104/103/104103019/
- https://nptel.ac.in/courses/104/101/104101090/
- https://nptel.ac.in/courses/104/105/104105103/

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 ~~+20~~** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester-I**	Session: **2024-2025**
1	**Course Code**	**CHSC-01P**		
2	**Course Title**	**CHEMISTRY LAB. COURSE-I**		
3	**Course Type**	**DSC**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *Analyze mixtures for cations (NH_4^+, Pb^{2+}, etc.) & anions (CO_3^{2-}, S^{2-}, etc.) using H_2S or other methods.* ➢ *Perform titrimetric analysis (standardization, unknown conc. determination).* ➢ *Estimate the concentration of acetic acid in vinegar (using NaOH), alkali content in antacids (using HCl), and free alkali in soaps/detergents.* ➢ *Utilize complexometric titrations for calcium (Ca^{2+}), water hardness, Fe^{2+}/Fe^{3+}, and Cu^{2+}.*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**QUALITATIVE INORGANIC MIXTURE ANALYSIS:** Inorganic mixture analysis containing up to four ionic species (two cations and two anions) using H_2S (hydrogen sulfide) or other appropriate methods (Excluded are interfering and insoluble salts) Cations and anions that may be encountered include: **Cations:** NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{2+}/Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Na^+ **Anions:** CO_3^{2-}, S^{2-}, SO_4^{2-}, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_2^-, SO_3^{2-} (Spot tests may be used wherever feasible.) **TITRIMETRIC ANALYSIS** Standardize sodium hydroxide solution using a standard oxalic acid solution. Determine the concentration of hydrochloric acid (HCl) solution using standardized sodium hydroxide solution as an intermediate.	**30**
Keywords	*Qualitative Analysis (H_2S method, Cations (NH_4^+, Pb^{2+}, etc.), Anions (CO_3^{2-}, S^{2-}, etc.), Titrimetric Analysis, Standardization (NaOH solution), Concentration Determination (HCl solution)*	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Gurtu, J. N., & Kapoor, R. (1987). *Experimental Chemistry*. S. Chand & Co.
2. Bajpai, D. N., Pandey, O. P., & Giri, S. (2013). *Practical Chemistry*. S. Chand & Co.
3. Ahluwalia, V. K., Dhingra, S., & Dhingram, S. (2005). *College Practical Chemistry*. Universities Press.
4. Kamboj, P. C. (2014). *Advanced University Practical Chemistry* (Part I). Vishal Publishing Co.
5. Fultariya, C., & Harsora, J. (2017). *Volumetric Analysis: Concepts and Experiments*.

Reference Books Recommended:

1. Mcpherson, P. A. (2015). *Practical Volumetric Analysis*. Royal Society Of Chemistry.
2. Shobha, R., & Banani, M. (2017). *Essentials of Analytical Chemistry*. Pearson.
3. Venkateswaran, V., Veeraswamy, R., & Kulandaivelu, A. R. (2004). *Basic Principles Of Practical Chemistry* (2nd Ed.). S. Chand Publications.
4. Sundaram, S., & Raghavan, K. (1996). *Practical Chemistry*. S. Viswanathan Co. Pvt.
5. Svehla, G. (2011). *Vogel's Textbook of Inorganic Qualitative Analysis* (7th Ed.). Pearson Education

Online Resources–

- https://bit.ly/3B7tOQV
- https://bit.ly/30V85ze
- https://bit.ly/3B5WOIQ
- https://bit.ly/3C9PXPS
- https://bit.ly/30Ip9rZ
- https://bit.ly/3BPnwqc

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **50 Marks**
Continuous Internal Assessment (CIA): **15 Marks**
End Semester Exam (ESE): **35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester - II**	Session: **2024-2025**
1	**Course Code**	**CHSC-02T**		
2	**Course Title**	**FUNDAMENTAL CHEMISTRY-II**		
3	**Course Type**	**DSC**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *To understand different acid-base theories and solvent system .* ➢ *To learn the preparation, bonding, and reactions of C-C σ- & π- bonded compounds* ➢ *To understand the concept and chemistry of aromatic compounds and their reactions* ➢ *To learn the basic concepts of various states of matter &understand the basic concepts of surface chemistry and chemical kinetics*		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Acid, Base and Solvent System** **Theories of acids and bases**: Arrhenius, Bronsted-Lowry, conjugate acids and bases, relative strengths of acids and bases, the Lux-flood, solvent system and Lewis concepts of acids and bases. **HSAB concept**: Classification of Acids and Bases According to HSAB Theory (Hard, Borderline, Soft). Applications of HSAB Theory in Inorganic Reactions - Solubility, Selectivity, Redox Reactions Non-aqueous solvents: .Physical properties of a solvent, types of solvents and their general characteristics, Liquid ammonia as a solvent. Acid-base, precipitation and complex, formation reactions. Solutions of alkali and alkaline earth metals in ammonia-application)	11
II	**CHEMISTRY OF C-C σ–BONDING** Alkanes: Preparation (Wurtz reaction, reduction/hydrogenation of alkenes, Corey-House method). Reactions (mechanisms): halogenation, free radical substitution. Cycloalkanes: Preparation (Dieckmann's ring closure, reduction of aromatic hydrocarbons), Reactions (mechanisms): substitution and ring-opening reactions. Stability of cycloalkanes -Baeyer's strain theory, Sachse and Mohr predictions, Conformational structures of ethane, n-butane and cyclohexane. **CHEMISTRY OF C-C π–BONDING** Alkenes: Preparation methods (dehydration, dehydrohalogenation, dehydrogenation, Hoffmann and Saytzeff rules, cis and trans eliminations). Reactions (mechanisms): electrophilic and free radical addition (hydrogen, halogen, hydrogen halide, hydrogen bromide, water, hydroboration, ozonolysis, dihydroxylation with $KMnO_4$). Dienes: 1,2- and 1,4-additions, Diels-Alder reactions. Alkynes: Preparation (dehydrohalogenation, dehydrogenation), Reactions: Acidity, formation of acetylides, addition of water, hydrogen halides and halogens, oxidation,	12

	ozonolysis, hydroboration/oxidation. **Aromatic Hydrocarbons** Aromatic hydrocarbons: Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/ carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directive effects of the groups.	
III	**Behaviour of ideal gases:** Kinetic theory of gases – postulates and derivation of the equation, $PV = 1/3\ mnc^2$ and derivation of the gas laws- Maxwell's distribution of molecular velocities-effect of temperature-types of molecular velocities-degrees of freedom-Principle of equipartition of energy. **Behaviour of Real gases:** Deviation from ideal behaviour, derivation of van der Waals, equation of state and critical constants. **Liquid state chemistry:** structure of liquids(Eyring Theory), Properties of liquids, viscosity and surface tension. **Solid state chemistry:** Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, Crystal defects.	**11**
IV	**A. Colloids and surface chemistry:** Classification, Optical, Kinetic and Electrical Properties of colloids, Coagulation, Hardy Schulze law, flocculation value, Protection, Gold number, Emulsion, micelles and types, Gel, Syneresis and thixotropy, Physical adsorption, chemisorption, **B. Chemical kinetics:** Rate of reaction, Factors influencing rate of reaction, rate law, rate constant, Order and molecularity of reactions, rate determining step, Zero, First and Second order reactions, Rate and Rate Law, methods of determining order of reaction, Chain reactions. Temperature dependence of reaction rate, Arrhenius theory, Physical significance of Activation energy, collision theory, demerits of collision theory, non-mathematical concept of transition state theory. **C. Catalysis:** Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristics of catalyst, Enzyme catalyzed reactions, Industrial applications of catalysis.	**11**
Keywords	***Acid & Bases, Alkanes, Cycloalkanes, Alkenes, Dienes, Alkynes, Aromatic Hydrocarbons, Kinetic theory of gases, Real gases, Intermolecular forces, Crystal structure, Chemical kinetics***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. *Bahl, A., & Bahl, B. S. (2014). Organic Chemistry (22nd Ed.). S. Chand & Sons.*
2. *Ahluwalia, V. K., & Goyal, M. (2001). A Textbook of Organic Chemistry. Narosa Publishing House.*
3. *Jain, M. K., & Sharma, S. C. (2017). Modern Organic Chemistry. Vishal Publishing Company.*
4. *Puri, B. R., Sharma, L. R., & Pathania, M. S. (2013). Principles of Physical Chemistry (46th Ed.). Shoban Lal Nagin Chand And Co.*
5. *Bahl, B. S. A., & Tuli, G. D. (2009). Essentials of Physical Chemistry (Multicolour Ed.). S. Chand & Company Pvt Ltd.*
6. *Puri, B. R., Sharma, L. R., & Kalia, K. C. (2018). Principles of Inorganic Chemistry. Nagin Chand and Co., New Delhi.*

Reference Books Recommended:

1. *Paula, B. Y. (2014). Organic Chemistry (7th Ed.). Pearson Education, Inc. (Singapore).*
2. *Solomons, T. W. G. (2017). Organic Chemistry (Global Ed.). John Wiley & Sons.*
3. *Morrison, R. T., & Boyd, R. N. (2010). Organic Chemistry (7th Ed.). Prentice-Hall Of India Limited.*
4. *Laidler, K. J., & Meiser, J. H. (2006). Physical Chemistry (2nd Indian Ed.). CBS Publishers.*
5. *Atkins, P. W., & De Paula, J. (2006). Physical Chemistry (8th Ed.). Oxford University Press.*
6. *Dogra, S., & Dogra, S. (2006). Physical Chemistry through Problems (2nd Ed.). New Age International.*
7. *Sangaranarayanan, M. V., & Mahadevan, V. (2011). Textbook of Physical Chemistry. University Press.*

Online Resources–

- https://bit.ly/3Gb99iy
- https://www.organic-chemistry.org/
- https://bit.ly/3GduvMi
- https://bit.ly/30TXm8d
- https://application.wiley-vch.de/books/sample/3527316728_c01.pdf
- https://www.ncbi.nlm.nih.gov/books/NBK547716/

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20** ~~**/20**~~ Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks

End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester- II**	Session: **2024-2025**
1	**Course Code**	**CHSC-02P**		
2	**Course Title**	**CHEMISTRY LAB. COURSE-II**		
3	**Course Type**	**DSC**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *Demonstrating and using common glassware for accurate measurements* ➢ *Studying the functional group analysis organic compounds* ➢ *Determining melting points to assess compound purity and employing distillation and sublimation techniques to establish boiling points* ➢ *Equipping with essential skills in measuring liquid surface tension and solution viscosity*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**Basic Laboratory Techniques** Demonstration of Laboratory Glassware and Equipment, Calibration of Thermometer : 80-82°C (Naphthalene), 113.5°-114°C (Acetanilide), 132.5°C - 133°C (Urea), 100°C (Distilled Water) **Functional group Analysis of Organic Compounds,** Detection of elements (N, S, and halogens) and functional groups **Physical chemistry** Surface tension measurements: Determine the surface tension by (i) drop number (ii) drop weight method. Surface tension composition curve for a binary liquid mixture. Viscosity measurement using Ostwald's viscometer, Determination of viscosity of aqueous solutions of (i) sugar (ii) ethanol at room temperature. Study of the variation of viscosity of sucrose solution with the concentration of solute. Viscosity Composition curve for a binary liquid mixture	**30**
Keywords	***Basic laboratory techniques, Equipments, Calibration, Melting points, Qualitative analysis, Physical chemistry, Surface tension, Viscosity***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. *Ahluwalia, V. K., Dhingra, S., & Gulati, A. (N.D.). College Practical Chemistry. University Press.*
2. *Khosla, B. D., Garg, V. C., & Gulati, A. (2011). Senior Practical Physical Chemistry. S. Chand & Co.*

Reference Books Recommended:

3. *Garland, C. W., Nibler, J. W., & Shoemaker, D. P. (2003). Experiments in Physical Chemistry (8th Ed.). Mcgraw-Hill.*
4. *Mendham, J. (2009). Vogel's Quantitative Chemical Analysis (6th Ed.). Pearson Education.*
5. *Mann, F. G., & Saunders, B. C. (2009). Practical Organic Chemistry. Pearson Education.*
6. *Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (2012). Practical Organic Chemistry (5th Ed.). Pearson Education.*

Online Resources–

- http://heecontent.upsdc.gov.in/Home.aspx
- https://nptel.ac.in/courses/104/106/104106096/
- http://heecontent.upsdc.gov.in/Home.aspx
- https://nptel.ac.in/courses/104/106/104106096/
- https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtml/introl.htm
- https://nptel.ac.in/courses/104/103/104103071/W

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **D. Performed the Task based on lab. work - 20 Marks** **E. Spotting based on tools & technology (written) – 10 Marks** **F. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Diploma/Degree/Honors)*			**Semester - III**	Session: **2024-2025**
1	**Course Code**	**CHSC-03T**		
2	**Course Title**	**INORGANIC AND PHYSICAL CHEMISTRY-I**		
3	**Course Type**	**DSC**		
4	**Pre-requisite**(if,any)	*As per Program*		
5	**Course Learning. Outcomes(CLO)**	➢ *Understand fundamental chemical concepts of transition elements and their applications.* ➢ *Master the principles of coordination chemistry.* ➢ *Grasp the core principles of thermodynamics and apply them to various phenomena.* ➢ *Explore the world of electrochemistry and its applications.*		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours -learning & Observation*	
7	**Total Marks**	**Max.Marks: 100**		**Min Passing Marks:40**

PART -B: Content of the Course

Total No.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No. of Periods
I	**Chemistry of d & f-block elements** **A. d-block elements (5 hrs.)** **(i) Chemistry of elements of first transition series:** Characteristic properties of the elements of first transition series with reference to their: Electronic configuration, Atomic and ionic radii, Ionization potential, Variable oxidation states, Magnetic properties, Color, Complex formation tendency and catalytic activity. **(ii) Chemistry of elements of second and third transition series:** Electronic configuration of 4d and 5d transition series. Comparative treatment with their 3d-analogous (Group Cr- Mo-W, Co-Rh-Ir) in respect of oxidation states and magnetic behavior. **B. f-block elements (6 hrs.)** **Chemistry of Lanthanide & Actinides:** Electronic structure, oxidation states, ionic radii, magnetic, and spectral properties. Lanthanide contraction and its consequences, complex formation, occurrence and isolation, Separation of lanthanides: solvent extraction and ion exchange method. General features and chemistry of actinides, Transuranic elements, chemistry of separation of Np, Pu and Am from uranium, similarities between the later actinides and the later lanthanides.	12
II	**Oxidation and reduction (5 hrs)** Various definitions of oxidation and reduction, Balancing of redox reaction by ion-electron method, Latimer diagram of Chlorine and Oxygen, Frost diagram of Nitrogen and Oxygen, and Pourbaix diagrams of Iron. Predicting disproportionation and comproportionation phenomena. **Coordination Chemistry (6 hrs)** **A. Coordination compounds:**Distinction among simple salts, double salts, and coordination compounds. Terminology and nomenclature of Coordination	11

	compounds. Types of ligands based on denticity. Werner's Coordination theory and its experimental verification. Sidgwicks electronic interpretation, EAN rule with examples. Electroneutrality principle, Valence Bond Theory of transition metal complexes. Determination of structures and magnetic properties of complexes based on VBT. Chelates: Classification and their application. **B) Isomerism in coordination compounds:** Structural isomerism and Stereoisomerism (Geometrical and optical) in coordination compounds with four and six coordination numbers.	
III	**Thermodynamics-I: (5 hrs)** **A. Basic concept of thermodynamics**: System, surrounding, types of system (closed, open & isolated). Intensive & extensive properties. Thermodynamic processes: isothermal, adiabatic, isobaric, isochoric, cyclic, reversible & irreversible. State function & path functions and their differentiation, concept of heat & work. Zeroth law of thermodynamics, First law of thermodynamics. Definition of internal energy & enthalpy. Concept of heat capacity, heat capacity at constant volume & at constant pressure, and their relationship. Joule-Thomson experiment, Joule-Thomson coefficient (no derivation) & inversion temperature. Calculations of w, q, E & H for expansion of gases for isothermal & adiabatic conditions for reversible process. **B. Thermochemistry(2 hrs.)** Standard states, Heat of reaction, enthalpy of formation, enthalpy of combustion, enthalpy of solution, enthalpy of neutralization, Hess's law of constant heat of summation & its applications. Variation of enthalpy change of reaction with temperature (Kirchoff's equation). **C. Thermodynamics II (4 hrs.)** **Second law of thermodynamics:** Limitations of first law and need for the second law. Statements of second law. Carnot cycle & Efficiency of heat engine. Thermodynamic principle of working of a refrigerator (Carnot theorem). Concept of entropy: entropy change in a reversible and irreversible process; entropy change in isothermal reversible expansion of an ideal gas. Physical significance of entropy. Gibbs free energy, Gibbs -Helmholtz equation. **D.Third law of thermodynamics (1 hr)** Statement of third law, Nernst heat theorem, Absolute entropy of solids, liquids, and gases.	12
IV	**Electrochemistry-1** Electrolyte conductance: specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch law, application of Kohlrausch law in determination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titrations. Single electrode potential, standard electrode potential, electrochemical series and its applications. Concept of overvoltage. Theory of strong electrolyte: limitation of Ostwald's dilution law weak and strong electrolyte, Debye-Huckel-Onsager's (DHO) equation for strong electrolytes, relaxation, and electrophoretic effect. Migration of ions: Transport number-definition and determination by Hittorf method and moving boundary method. Electrochemical cells or Galvanic cells: reversible and irreversible cells, conventional Representation of electrochemical cells. EMF of a cell, effect of temperature on EMF of cell, Nernst equation calculation of ΔG, ΔH and ΔS for cell reaction, polarization, Over potential and hydrogen overvoltage.	11
Keywords	***D & f-block elements, Coordination compounds, Werner's theory, VBT, Isomerism, Thermodynamics, Thermochemistry, Electrical/electrolytical conductance, Transport number.***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Jauhar, S. P. (2010). Modern Approach to Inorganic Chemistry: A Textbook for B. Sc. I Students. Modern publishers*
2. *Bajpai, D. N. (1992). Advanced book of physical chemistry. S Chand publishing.*
3. *Sharma, k. K. & Sharma, L. K. (2016). A textbook of physical chemistry. Vikas publishing.*
4. *Bhasin, K. K. (2018). Pradeep's Inorganic Chemistry Vol.III. Pradeep publications.*
5. *Puri, S., & Sharma, L. R. (2008). Kalia "Principles of Inorganic Chemistry".*

Reference Books recommended-

Inorganic Chemistry

1. *Lee, J. D. (2008). Concise inorganic chemistry. John Wiley & Sons.*
2. *Cotton, F. A., Wilkinson, G., &Gaus, P. L. (1995). Basic inorganic chemistry. John Wiley & Sons.*
3. *Huheey, J. E., Keiter, E. A., Keiter, R. L., & Medhi, O. K. (2006). Inorganic chemistry: principles of structure and reactivity. Pearson Education India.*
4. *Douglas, B. E., McDaniel, D. H., & Alexander, J. J. (1994). Concepts and models of inorganic chemistry, John Wiley & Sons*

Physical Chemistry

1. *Puri, L. B., Sharma, L. R., & Pathania, M. S. (2013). Principles of physical chemistry. Vishal Publishing Co.*
2. *Atkins, P. W., De Paula, J., & Keeler, J. (2023). Atkins' physical chemistry. Oxford university press.*
3. *McQuarrie, D. A., & Simon, J. D. (2004). Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://www.geeksforgeeks.org/d-block-elements/**
- **https://www.vedantu.com/evs/lanthanides-vs-actinides**
- **https://www.livescience.com/50776-thermodynamics.html**
- **https://byjus.com/jee/electrochemistry/**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
EndSemester Exam(ESE): 70 Marks

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** ~~/20~~ Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Diploma / Degree/Honors)*			**Semester - III**	Session: **2024-2025**
1	**CourseCode**	**CHSC-03P**		
2	**CourseTitle**	**CHEMISTRY LAB. COURSE-III**		
3	**CourseType**	**DSC**		
4	**Pre-requisite**(if,any)	-		
5	**Course Learning. Outcomes(CLO)**	➢ *Understand the principle of determining transition temperature of hydrated or other allotropic salts.* ➢ *Employ the principle of determination of solubility of a given salt at different temperatures.* ➢ *Apply Born-Haber cycle to determine enthalpy and lattice energy.* ➢ *Determine strength of an acid, ionization constant of weak acid and solubility product by conductometric or potentiometric titrations.*		
6	**CreditValue**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**TotalMarks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content of the Course

Total No. of learning-Training/performancePeriods:30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Transition Temperature** 1) Transition temperature of a salt hydrate – determination of molecular weight. 2) Determination of the transition temperature of the given substance by thermometric /dialometric method (e.g. $SrBr_2.2H_2O$ or $MnCl_2.4H_2O$). **Thermochemistry** **A. Determination of solubility:** 1) To determine the solubility of benzoic acid at different temperatures and to determine **ΔH** of the dissolution processes. **B. Calorimetry:** 1) To determine the enthalpy of neutralization of hydrochloric acid (strong acid) by sodium hydroxide (strong base) solution. 2) (a) To determine the enthalpy of neutralization of a weak acid (acetic acid) versus strong base (sodium hydroxide) and determine enthalpy of ionization of weak acid. (b) To determine the enthalpy of neutralization of a weak base (ammonium hydroxide) versus strong acid (hydrochloric acid) and determine enthalpy of ionization of weak base. 3) To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy. **Conductometry** 1) Conductometry – Determination of limiting molar conductance of a strong Electrolyte (KCl). 2) To determine the strength of the given acid (HCl or CH3COOH)conductometrically	**30**

	using standard alkali (NaOH) solution. 3) To determine the strength of strong acid and a week acid in the given mixture conductometrically against a standard alkali solution. 4) To determine the ionization constant of weak acid conductometrically. **Solubility Product** 1) To determine the solubility and solubility product of a sparingly soluble salt conductometrically. 2) Potentiometry – Determination of solubility product of a sparingly soluble substance.	
Keywords	***Solution, Acid, Alkali. Transition temperature, Thermochemistry, Temperature, Enthalpy, Conductometric titrations, Potentiometric titrations, Solubility product.***	

SignatureofConvener&Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Vishwanathan, B. & Raghavan, P. S. (2017). Practical Physical Chemistry. Viva books originals publishing.*
2. *Yadav, J. B. (2006). Advanced Practical Physical Chemisty. Krishna Prakashan Media.*
3. *Sahu, D. P.& Bapat, K. N. (2022) Unified practical chemistry, Navbodh Prakashan.*

Reference Books recommended:

1. *Moudgil, H. K. (2010). Textbook of physical chemistry. PHI Learning Pvt. Ltd.*
2. *Adamson, A. (2012). A textbook of physical chemistry. Elsevier.*
3. *Findlay, A. (1923). Practical physical chemistry. Longmans, Green.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://tech.chemistrydocs.com/Books/Physical/Advanced-Physical-Chemistry-Experiments-by-J-N-Gurtu-&-Amit-Gurtu.pdf**
- **https://byjus.com/chemistry/conductometric-titration/**
- **https://chem.libretexts.org/Courses/University_of_California_Davis/Chem_4B_Lab%3A_General_Chemistry_for_Majors_II/1%3A_Thermochemistry_(Experiment)**
- **https://www.ulm.edu/chemistry/courses/manuals/chem1010/experiment_10.pdf**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA): 15 Marks
End Semester Exam(ESE): 35 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **G. Performed the Task based on lab. work - 20 Marks** **H. Spotting based on tools & technology (written) – 10 Marks** **I. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelor in Science *(Diploma/Degree/Honors)*		Semester - IV	Session: 2024-2025
1	Course Code	CHSC-04T	
2	Course Title	ORGANIC AND PHYSICAL CHEMISTRY-I	
3	Course Type	DSC	
4	Pre-requisite(if,any)	-	
5	Course Learning. Outcomes(CLO)	➢ *Master the synthesis, properties, and reactivity of various functional groups and apply this knowledge to understand their significance in organic chemistry.* ➢ *Employ the principles of chemical/ionic equilibria, their influencing factors and applications* ➢ *Interpret phase diagrams for one and two-component systems, determine degrees of freedom, and identify the triple point.* ➢ *Master the principles and applications of liquid-liquid mixtures using Raoult's law, Henry's law, and Nernst distribution law.*	
6	Credit Value	3 Credits	*Credit = 15 Hours -learning & Observation*
7	Total Marks	Max.Marks: 100	Min Passing Marks:40

PART -B: Content of the Course

Total No.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No.of Period
I	**A. Halides (5 hrs)** **(i) Alkyl Halides**: Preparation: from alkenes and alcohols. Reactions: Nucleophilic substitution reactions of alkyl halides (alcohol, ester, nitrile & isonitrile formation, Williamson's ether synthesis), mechanism and stereochemistry of nucleophilic substitution reactions (SN1 and SN2), factors affecting SN1 and SN2 reactions. **(ii) Aryl Halides:** Chlorobenzene: Preparation by aromatic halogenation and Sandmeyer reaction. Aromatic nucleophilic substitution involving Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl and aryl/ Vinyl halides. **B. Alcohols & Phenols (7hrs)** **(i)Alcohols** **(a)Monohydric**-nomenclature, methods of formation, Properties & chemical reactions distinction between primary, secondary & tertiary alcohols. **(b)Dihydric alcohols:** Nomenclature, methods of formation of ethylene glycol (from ethylene, epoxide, ethylene dibromide and ethylene diamine). Chemical reactions of vicinal glycols: with carbonyl compounds, dehydration, oxidative cleavage with Pb(OAc)4 and HIO4 and Pinacol–Pinacolone rearrangement (with mechanism). **(c) Trihydric alcohols:** Nomenclature and methods of formation (from hydrolysis of fats and oils, propene and acrolein), chemical reactions of glycerol (with PCl5, HI, oxidation, and dehydration) and uses/applications. **(ii)Phenols** Nomenclature and methods of formation, physical properties, and acidic character. Resonance stabilization of phenoxide ion. Comparative acidic strength of alcohols and phenols. Electrophilic aromatic substitution, acetylation, and carboxylation. Mechanism of Fries rearrangement, Claisen rearrangement, and Reimer-Tiemann reaction.	12

II	**Aldehydes/Ketones and acid/its derivatives** **A. Aldehydes and Ketones (6 hrs)** Nomenclature and structure of the carbonyl group, synthesis of aldehydes and ketones. Acidity of alpha hydrogens and formation of enolate, Concept of reactive methylene group, Keto-enol tautomerism in Acetoacetic ester. Oxidation of aldehydes by KMnO4, and Tollen's reagent, Reduction of aldehydes by $LiAlH_4$ and $NaBH_4$. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on aldol, Perkin, and Knoevenagel reactions. Wittig and Mannich reaction (without mechanism), Baeyer-Villiger oxidation of Ketones (without mechanism), Cannizaro reaction (with mechanism), MPV, Clemmensen, and Wolf-Kishner reaction. **B. Acid & its derivatives (5 hrs)** **(i) Carboxylic Acids** Nomenclature, structure, physical properties, acidity of carboxylic acids, effect of substituent on acid strength, method of preparation and chemical reaction. Hell-Volhard –Zeilinsky (HVZ) reaction, Reduction of carboxylic acids, Mechanism of decarboxylation. Di carboxylic acids: - Methods of formation and chemical reactions, effect of heat and Dehydrating agents. **(ii) Carboxylic Acid Derivatives** Structure, method of preparation & physical properties of acid chlorides, esters, amides (Urea) and acid anhydrides. Relative stability of acyl derivatives.	11
III	**Equilibrium** **A. Chemical equilibria (3 hrs)** Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constants and their quantitative dependence on temperature, pressure, and concentration, factors affecting equilibrium – Le Chatelier's principle. **B. Ionic Equilibria (5 Hrs)** Ionization of acids and bases, Strong and weak electrolytes, degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect and solubility product (with illustrative examples), Salt hydrolysis - calculation of hydrolysis constant and degree of hydrolysis for salt of strong acid and weak base, Buffer solutions – Introduction, Henderson-Hasselbalch equations for acidic and basic buffer. **(C). Phase Equilibrium (3 hrs)** (A)Gibbs phase (no derivation), phase, component and degree of freedom, Application of phase rule to one component system (water system and Sulphur systems), Reduced phase rule. Application of phase rule to two component systems: Pb-Ag system. Congruent-Ferric chloride system.	11
IV	**Photochemistry and liquid-liquid mixtures** **A) Photochemistry (8 hrs)** Interaction of radiation with matter, difference between thermal and photochemical reactions, Laws governing absorption of light, laws of photochemistry, Jablonski diagram depicting various processes, quantum yield, determination of quantum yield of reactions, reasons for low and high quantum yields. Some examples of photochemical reactions (e.g. Photochemical decomposition of Hydrogen iodide, Photosynthesis of HBr from H_2 and Br_2 and photosynthesis of HCI from H_2 and Cl_2). Photosensitization and Quenching, Photosensitized reactions. **B)Liquid-Liquid mixtures(3 hrs)** Ideal liquid mixtures, Raoult's law of ideal solutions, Henry's law and its applications, Nernst distribution law, limitations, and applications (association and dissociation - No derivation).	11
Keywords	***Halides (alkyl & aryl halides), Alcohols, Phenols, Aldehydes & Ketones, Carboxylic acids & their derivatives, Equilibrium (Chemical, Ionic, and Phase equilibria), Photochemistry, Liquid-liquid mixtures.***	

Signature of Convener &Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Bahl, A. (2010). Advanced organic chemistry. S. Chand publishing.*
2. *Singh, J & Yadav, L. D. S. (2016) Advanced organic chemistry. Pragati Prakashan Meerut.*
3. *Puri, L. B., Sharma, L. R., & Pathania, M. S. (2013). Principles of physical chemistry. Vishal Publishing Co.*
4. *Kapoor, K. L. (2019). A Textbook of Physical Chemistry, Thermodynamics and Chemical Equilibrium (SI Units) - Vol. 2, 6th Edition.*

Reference Books recommended-

1. *Boyd, R. N., & Morrison, R. T. (1983). Organic Chemistry:(uden title). Allyn and Bacon.*
2. *Physical Chemistry*
3. *Atkins, P. W., De Paula, J., & Keeler, J. (2023). Atkins' physical chemistry. Oxford university press.*
4. *McQuarrie, D. A., & Simon, J. D. (2004). Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://ncert.nic.in/ncerts/l/lech202.pdf**
- **https://unacademy.com/content/wp-content/uploads/sites/2/2022/10/30.-Aldehydes-Ketones-and-Carboxylic-Acid.pdf**
- **https://egyankosh.ac.in/bitstream/123456789/68232/3/Unit-3.pdf**
- **https://magadhmahilacollege.org/wp-content/uploads/2020/04/photochemistry_and_jablonski_diagram_M.sc_II_Sem.pdf**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
End Semester Exam(ESE): 70 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20+20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Diploma / Degree/Honors)*			**Semester - IV**	Session: **2024-2025**
1	**Course Code**	**CHSC-04P**		
2	**Course Title**	**CHEMISTRY LAB. COURSE-IV**		
3	**Course Type**	**DSC**		
4	**Pre-requisite(if, any)**	*As per Program*		
5	**Course Learning. Outcomes(CLO)**	➢ *Understand the fundamentals of organic compounds analysis including preparation of sodium extract and detection of elements.* ➢ *Identify functional groups and prepare derivatives.* ➢ *Determine the pH of various samples like water/acid/base/soil etc.* ➢ *Apply the concepts of phase equilibria to determine critical solution temperature and study concepts of Nernst distribution law and determine equilibrium constant of various reactions.*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content of the Course		
Total No. of learning-Training/performancePeriods:30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Periods**
Lab./Field Training/ Experiment Contents of Course	**Organic Analysis** ***Systematic identification of organic compounds:*** a. Test for aliphatic and aromatic nature of substances. b. Test for saturation and unsaturation. c. Detection of elements (N, S, and halogens) in organic compounds. d. Identification of functional groups: i) Carboxylic acids ii) Phenols iii) Aldehydes iv) Ketones, v) Esters vi) Carbohydrates vii) Amines viii) Amides, ix) Halogen compounds e. Determination of melting and boiling points. f. Preparation of solid derivatives. **pH determination** Determination of pH of soil, water. To measure the pH of various solutions using pH indicators and pH meter. To determine the value of Ka for an unknown acid. To prepare and study the properties of buffer solutions. **Phase Equilibrium:** 1) To determine the critical solution temperature of two partially miscible liquids (phenol-water systems). 2) To study the effect of solute such as (i) sodium chloride (NaCl), (ii) succinic acid ($HOOC-CH_2-CH_2-COOH$) on the critical solution temperature of two partially miscible liquids (e.g. phenol – water system). 3) To construct the phase diagram of two components (e. g. diphenylamine-benzophenone system) by cooling curve method. **Nernst Distribution Law** 1) To determine the partition coefficient of Iodine between water and carbon tetrachloride/Kerosene. 2) To determine the partition coefficient of benzoic acid between water and benzene.	**30**

	3) To determine the equilibrium constant of the reaction, $KI + I_2 = KI_3$ by distribution method.	
Keywords	***Organic analysis, Aromatic/Aliphatic compounds, Saturated/unsaturated compounds, Element detection, Functional groups, Derivatives for functional groups, pH, Phase equilibria, Nernst distribution law.***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Sahu, D. P.& Bapat, K. N. (2022) Unified Practical Chemistry, Navbodh Prakashan.*
2. *Yadav, J. B. (2006). Advanced Practical Physical Chemistry. Krishna Prakashan Media.*
3. *Pandey, O. P., Bajpai, D. N., Giri, S. (2010). Practical Chemistry. S. Chand Publisher.*

Reference Books Recommended:

1. *Moudgil, H. K. (2010). Textbook of Physical Chemistry. PHI Learning Pvt. Ltd.*
2. *Adamson, A. (2012). A Textbook Of Physical Chemistry. Elsevier.*
3. *Findlay, A. (1923). Practical Physical Chemistry. Longmans, Green.*
4. *Leonard. J, Lygo. B & Procter, G. (2013). Advanced Organic Practical Chemistry, CRC Press.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://faculty.ksu.edu.sa/sites/default/files/vogel_-_practical_organic_chemistry_5th_edition.pdf**
- **https://tech.chemistrydocs.com/Books/Physical/Advanced-Physical-Chemistry-Experiments-by-J-N-Gurtu-&-Amit-Gurtu.pdf**
- **https://byjus.com/chemistry/conductometric-titration/**
- **https://chem.libretexts.org/Courses/University_of_California_Davis/Chem_4B_Lab%3A_General_Chemistry_for_Majors_II/1%3A_Thermochemistry_(Experiment)**
- **https://www.ulm.edu/chemistry/courses/manuals/chem1010/experiment_10.pdf**
- **https://www.masterjeeclasses.com/wp-content/uploads/2019/02/11.Practical-Organic-ChemistryTheory.pdf**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **50 Marks**

Continuous Internal Assessment(CIA): **15 Marks**

End Semester Exam(ESE): **35 Marks**

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **J. Performed the Task based on lab. work - 20 Marks** **K. Spotting based on tools & technology (written) – 10 Marks** **L. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Degree/Honors)*			**Semester -V**	Session: **2024-2025**
1	**Course Code**	**CHSC-05T**		
2	**Course Title**	**ORGANIC AND INORGANIC CHEMISTRY - I**		
3	**Course Type**	**DSC**		
4	**Pre-requisite(if,any)**	***As per Program***		
5	**Course Learning. Outcomes(CLO)**	➢ ***Explore role of nitrogen in organic chemistry by studying N-containing compounds and heterocycles.*** ➢ ***Unravel molecular structures using techniques like rotational, vibrational, and Raman spectroscopy.*** ➢ ***Demystify bonding in transition metal complexes, including stability, lability, and magnetic properties.*** ➢ ***Understand the importance of organometallic and inorganic compounds in biological systems.***		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours -learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks:40**

PART -B: Content oftheCourse		
TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)		
Unit	**Topics(Course contents)**	**No. of Periods**
I	**(A)Organic Compound of Nitrogen** Preparation of Nitroalkanes and Nitroarenes, Chemical properties of nitroalkanes, Mechanism of nucleophilic substitutions in nitroarenes, Reduction of nitroalkane in acidic, neutral, and alkaline medium.Picric acid Amines:- Nomenclature, Structure and stereochemistry. Basicity, Structural feature effecting basicity of amines. separation of primary, secondary and tertiary ammines. Amine salt as phase transfer catalyst. Preparation of alkyl and aryl amines:- reduction of nitro compound, reductive amination of aldehydic and ketonic compounds. Gabriel Phthalimide reaction, Hoffmann Bromamide reaction. Physical and chemical properties of amine: electrophilic aromatic substitution in aryl amines, reaction of amines with nitrous acid, synthetic transformation of aryl diazonium salts, Azo-coupling reaction.	**12**
II	**Spectroscopy:** General introduction, electromagnetic radiation, region of spectrum, representation of spectral width and intensity of spectral transition. (A)Rotational spectra of diatomic molecule as rigid rotor, selection rule, energy level, transition, spectra. Determination of bond length, Isotope effect, Qualitative description of non-rigid rotor. (B)Vibrational Spectra: Fundamental vibrational bands and their symmetry. Diatomic molecule as harmonic oscillator. Selection rule, pure vibrational spectrum, Determination of force constant Anharmonic oscillator. (C)Raman Spectra: introduction, concept of polarization, quantum theory, stoke and antistoke line, pure rotational and vibrational Raman spectra. Applications of Raman spectra.	**11**
III	**(A)Metal Ligand Bonding in Transition Metal Complex:** postulate of CFT. Splitting of d orbitals in octahedral, tetrahedral complex, Spectro-chemical series, Calculation of CFSE, Factors affecting CFSE, Applications of CFSE, Jahn-Teller Distortion, Limitations of CFT. **(B) Thermodynamic and Kinetic aspects of Metal Complexes:** A brief introduction of	**11**

	thermodynamic and kinetic stability of complex, Stepwise and overall stability constant. (C) Magnetic properties: Types of magnetic behavior, Methods of determining magnetic susceptibility, Spin Only formula, L-S Coupling, Calculation of effective magnetic moment, Orbital contribution to magnetic moment.	
IV	**(A)Organometallic Chemistry:** Definition, nomenclature, and Classification of organometallic compounds. Preparation, properties, bonding and application of alkyls and aryls of Li, Al. A brief account of metal ethylenic metal complexes special reference to Zeisse's salt. Mononuclear carbonyls and nature of bonding in metal carbonyls. 18 electron rules(Effective Atomic Number Rule). Ziegler-Nata Catalyst for polymerization of alkene, Wilkinson Catalyst and Hydrogenation , Hydroformylation. **(B)Bioinorganic Chemistry:** Essentials and trace elements in biological system, metalloporphyrins, with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metals with special reference to Na^+ K^+ Ca^{2+} and Mg^{+2}, Nitrogen fixation.	**11**
Keywords	***Amines, Nitro compounds, Zeigler-Nata Catalyst, Wilkinson Catalyst, rigid rotor, harmonic oscillator, Hemoglobin, myoglobin.***	

SignatureofConvener&Members:

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Bahl, A., & Bahl, B. S. (2020). Organic chemistry (5th ed.). S. Chand & Company.*
2. *Madan, R. D. (2018). Advanced organic chemistry. S. Chand & Company.*
3. *Soni, P. L. (2019). A textbook of organic chemistry. S. Chand & Company.*
4. *Sharma, B. K. (2015). Spectroscopy. GOEL Publishing House.*
5. *Kaur, H. (2018). Spectroscopy. Pragati Prakashan.*
6. *Das, A. K. (2012). Bioinorganic Chemistry. Publisher.*

Reference Books Recommended:

1. *Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). Principles of Instrumental Analysis. Cengage Learning.*
2. *Mehrotra, R. C. (2010). Organometallic Chemistry. New Age International.*
3. *Carbtree, R. H. (2014). Organometallic Chemistry of the Transition Metal. University Science Books.*
4. *Housecroft, C. E., & Sharpe, A. G. (2012). Inorganic Chemistry. Pearson.*
5. *Miessler, G. L., Fischer, P. J., & Tarr, D. A. (2010). Inorganic Chemistry. Pearson.*

Online Resource:

- **e-Resources / e-books and e-learning portals**
- **https://onlinecourses.nptel.ac.in/noc23_cy01/preview**
- **https://pubs.rsc.org/en/content/articlelanding/1978/f2/f29787401203**
- **https://onlinecourses.swayam2.ac.in/cec23_cy03/preview**
- **https://onlinecourses.nptel.ac.in/noc22_cy12/preview**

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
End Semester Exam(ESE):70 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** Assignment/Seminar- **10** Total Marks -**30**	Better marks out of the two Test / Quiz+ obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelor in Science *(Degree/Honors)*	Semester -V	Session: 2024-2025

1	CourseCode	CHSC-05P	
2	CourseTitle	CHEMISTRY LAB COURSE -V	
3	CourseType	DSC	
4	Pre-requisite(if,any)	*As per Program*	
5	Course Learning. Outcomes(CLO)	➢ *To apply the knowledge of qualitative and quantitative estimations in real sample analysis.* ➢ *To get 'Hands on Training' and develop skill for synthesis of various inorganic compounds.* ➢ *To learn the concept of gravimetric estimation.* ➢ *To learn use of conductometer and spectrophotometer for titration.*	
6	CreditValue	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*
7	Total Marks	Max.Marks:50	Min Passing Marks:20

PART -B: Content oftheCourse

TotalNo.of learning-Training/performancePeriods:30 Periods (30 Hours)

Module	Topics(Coursecontents)	No.ofPeriod
Lab./Field Training/ Experiment Contents of Course	1)To verify Beer-Lambert Law for $KMnO_4$/ $K_2Cr_2O_7$ and determine the concentration of the given solution of the substrate from absorbance measurement. 2)To Determine the strength of the given acid conductometrically using standard alkali solution. 3)Gravimetric estimation of Ba as $BaSO_4$ from given solution of $BaCl_2$. 4)Inorganic compound synthesis: (i) Synthesis of sodium trioalato ferrate(III) $Na_2[Fe(C_2O_4)_3]$ and determination of its composition by permangnometry. (ii) Synthesis of Ni-dimethylglyoxime complex $[Ni(dmg)_2]$ (iii) Synthesis of Tetraaminecopper(II) sulphate $[Cu(NH_3)_4]SO_4$ (iv) Synthesis of Cis- and Trans-bisoxalateochromate(III)ion.	30
Keywords	*Spectrophotometer, Lambert beers law, Gravimetric estimation, synthesis of inorganic complexes*	

Signature of Convener &Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books:

1. Chatwal, G. R., & Sharma, A. (n.d.). *Instrumental methods of chemical analysis*. Himalaya Publishing House.
2. Raj, G. (2009). *Advanced Practical Inorganic Chemistry*. Krishna Prakashan.

Reference Books:

1. Svehla, G. (Ed.). (1978). *A textbook of quantitative inorganic analysis* (by A. I. Vogel). ELBS Publishers and Distributors. (Original work published 1968)
2. Henderson, W. A. (n.d.). *Inorganic synthesis*. Benjamin-Cummings Publishing Company.
3. Fernelius, W. G. (2009). *Experimental inorganic chemistry* (Adapted by R. K. Sharma & G. Panda). New Age International Publishers. (Original work published 1972)
4. Mendham, J., Denney, R. C., Barnes, J. D., & Thomas, M. (Eds.). (2000). *Vogels textbook of quantitative chemical analysis* (6th ed.). Pearson Education India. (Original work by A. I. Vogel)
5. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (Eds.). (1989). *Vogel's textbook of practical organic chemistry* (5th ed.). Longman Scientific & Technical. (Original work by A. I. Vogel)

Online Resources:

- **e-Resources / e-books and e-learning portals**
- **https://www.youtube.com/watch?v=s7pXbV9dumI**
- **https://onlinelibrary.wiley.com/series/2146**
- **https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/General_Chemistry_Labs/Online_Chemistry_Lab_Manual/Chem_11_Experiments/07%3A_Gravimetric_Analysis_(Experiment)**
- **https://mas-iiith.vlabs.ac.in/exp/beer-lambert-law/**

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
End Semester Exam(ESE):35Marks

Continuous Internal Assessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- **05** Total Marks **-15**	Better marks out of thetwo Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **M. Performed the Task based on lab. work - 20 Marks** **N. Spotting based on tools& technology (written) – 10 Marks** **O. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Degree/Honors)*			**Semester -VI**	Session: **2024-2025**
1	**Course Code**	**DSC-06T**		
2	**Course Title**	**ORGANIC AND PHYSICAL CHEMISTRY- II**		
3	**Course Type**	**DSC**		
4	**Pre-requisite**(if,any)	*As per Program*		
5	**Course Learning. Outcomes(CLO)**	➢ *To understand role of quantum mechanics in chemistry.* ➢ *To know the organic compound in biological system* ➢ *To know the polymers in chemistry their preparation and application of polymer.* ➢ *To learn the techniques for studying the structure of chemical molecule.*		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours -learning & Observation*	
7	**Total Marks**	**Max.Marks: 100**		**Min Passing Marks:40**

PART -B: Content of the Course

Total No.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No. of Periods
I	**Quantum Chemistry I:**-Black body radiation ,plank's radiation law, photoelectric effect, Compton effect, de-Broglie's idea of matter and waves and its experimental verification. Heisenberg's uncertainty principle, operators: Hamiltonian operator, angular momentum operator, Laplacian operator, postulates of quantum mechanics, Eigen values, Eigen function, Schrodinger time independent wave equation, physical significance of Ψ and Ψ^2. Application of Schrodinger wave equation to Particle in one dimensional box. **Quantum Chemistry II:**-Quantum mechanical approach of molecular orbital theory basic idea, criteria of forming Molecular orbitals, LCAO(Linear combination of atomi orbital) approximation, formation of H_2^+ ion, calculation of energy of energy levels fron wave functions, bonding and antibonding wave functions, concept of sigma bonding sigma antibonding, pi bonding and pi anti bonding M.Os. and their characteristics Comparison of M.O. theory and V.B. Model.	12
II	**(A)Carbohydrate:** Introduction and classification of carbohydrate, monosaccharide: open chain and cyclic structure of glucose and fructose, epimer and anomers of glucose. Relative and absolute configuration of carbohydrates, Specific rotation and mutarotation of glucose. Determination of ring size in glucose. Chemical properties of gluose: Osazone formation, oxidation, reduction, Reaction with HIO_4, Interconversion of Glucose and fructose, Chain lengthening and chain shortening. Structure of Disaccharide Sucrose, Lactose and Maltose. Structure of polysaccharide: Starch, Cellulose. **(B) Amino Acid & Protein**: amino acid types of amino acid, isoelectric point, structure of protein primary, secondary and tertiary structure. **(C) Nucleic Acid:** components of nucleic acid, types of nucleic acid, nucleoside, nucleotide, structure of nucleic acid.	11
III	**(A)Organometallic compound:** Preparation, Structure, and chemical reactions of organomagnesium(Grignard Reagent), Organozinc compound, Organolithium compound, Organosulphur compound **(B) Synthesis of organic compound via enolates :** Active methylene compound, Keto-enol tautomerism, Alkylation of diethyl malonate and acetoacetic ester. Claisen ester	11

	condensation and Robinson anealation. Synthesis of monoalkyl and dialkyl derivative, fatty acids, dibasic acid, α, β unsaturated acid, valeric acid, monoketone, diketone, heterocyclic compounds etc.	
IV	Spectroscopy II(Organic) (A) Infra red Spectroscopy: Basic principle and instrumentation, introduction, Modes of vibrations, fundamental band of different bond and functional groups, identification of band for compound and IR spectra of different compounds. Applications of IR spectroscopy. (B)Principle and instrumentation of UV-visible spectroscopy, Introduction, wavelength maxima, Beer Lambert's Law, Shifts in UV-visible spectra, Chromophore –Auxochrome theory, Effect of conjugation on wavelength maxima. Types of electronic transitions. Applications of UV-visible spectroscopy. Woodward Fischer rule for polyene wavelength maxima calculation. (C) NMR (Nuclear Magnetic Resonance): Introduction to NMR, Basic principle and instrumentation, No. of signal in PMR(proton Magnetic Resonance),Chemical shift, Sheilding and deshielding effect, Splitting of signal or spin-spin interaction, Intensity of Signal and peak height and peak ratio. Coupling Constant J. Proton NMR of some compound like ethanol, propanol, toluene, acetaldehyde, ketone,1,2-dibromoethylene etc.	**11**
Keywords	***Particle in one Dimensional Box, Hydrogen atom, Proton NMR, UV Visible, Vibrational Spectra. Woodward Fischer Rule.***	

SignatureofConvener&Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Tandon, M. M. N., & Agarwal, S. C. (2022). Unified chemistry. Shivalal and Company.*
2. *Sharma, B. K. (2010). Spectroscopy comprehension. Goel Publishing House.*
3. *Puri, B. R., Sharma, L. R., & Pathania, M. S. (2021). Principles of physical chemistry. Vishal Publications.*
4. *Gurtu, J. N., & Gurtu, R. (2015). Advanced physical chemistry. Pragati Prakashan.*

Reference Books Recommended:

5. *Atkins, P. W., de Paula, J., & Keeler, J. A. (2005). Atkins' physical chemistry Oxford University Press.*
6. *Pandya, A. J. (2010). A textbook of biochemistry: Nucleic acids, proteins and carbohydrates.*
7. *Korte, F., & Goto, M. (2009) Nucleic acids, proteins and carbohydrates, John Willy & Sons*

Online Resources:

- **https://onlinecourses.nptel.ac.in/noc23_cy09/preview**
- **https://www.udemy.com/course/ochemnmr/?couponCode=LEADERSALE24A**
- **https://en.wikipedia.org/wiki/Bioorganic_chemistry#:~:text=Biophysical%20organic%20chemistry%20is%20a,nature%20to%20determine%20their%20properties.**
- **https://onlinecourses.nptel.ac.in/noc21_cy38/preview**

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
End Semester Exam(ESE):70 Marks

Continuous Internal Assessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20** ~~40~~ **20** Assignment/Seminar- **10** Total Marks -**30**	Better marks out of the two Test / Quiz+ obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40Marks**	

Name and Signature of Convener & Members ofCBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Diploma / Degree)*			**Semester VI**	Session: **2024-2025**
1	**CourseCode**	**CHSC-06P**		
2	**CourseTitle**	**CHEMISTRY LAB COURSE-VI**		
3	**CourseType**	**DSC**		
4	**Pre-requisite(if,any)**	*As per Program*		
5	**Course Learning. Outcomes(CLO)**	➢ *To understand the basic principles involved in separation and identification of organic compound.* ➢ *To apply the knowledge of qualitative and quantitative estimations in real sample analysis.* ➢ *To learn the synthesis of organic compounds* ➢ *To learn the use of conductometer and spectrophotometer in analysis.*		
6	**CreditValue**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**TotalMarks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content oftheCourse		
TotalNo.of learning-Training/performancePeriods:30 Periods (30 Hours)		
Module	**Topics(Coursecontents)**	**No.ofPeriod**
Lab./Field Training/ Experiment Contents of Course	1)To determine the solubility and solubility product of Sparingly soluble salt using conductometer. 2)To titrate potentiometrically the given ferrous sulphate solution using KMnO4 / $K_2Cr_2O_7$ as titrant and calculate redox potential of Fe^{2+} /Fe^{3+} system on the hydrogen scale. **Organic mixture analysis** Separation and Identification of two solid organic compounds from given binary organic mixture by H_2O,$NaHCO_3$, NaOH for separation and preparation of suitable derivative. **Synthesis of one organic compound :-** (a)synthesis of m-dinitrobenzene from nitrobenzene. (b) synthesis of acetanilide from aniline (c)Preparation of iodoform from ethanol and acetone (d)Preparation of p-bromoacetanilide (e)Preparation of 2,4,6-tribromophenol. (f)Preparation of methyl orange and methyl red. (g)Preparation of benzoic acid from toluene. (h)Preparation of aniline from nitrobenzene.	**30**
Keywords	***Organic mixture analysis, synthesis of organic compound, solubility product, conductometer.***	

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Tandon, M. M. N., & Shiva Lal Agarwal & Company. (2012). BSc. Practical Chemistry.*
2. *Pandey, O. P., BajPai, D. N., Giri, S., & S. Chand. (2013). Practical Chemistry.*

Reference Books Recommended:

1. *Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (2000). Vogel's Text Book of Qualitative Analysis (revised). ELBS.*
2. *Das, R. C., & Behra, B. (2002). Experimental Physical Chemistry. Tata McGrawHill.*

Online Resources:

- **e-Resources / e-books and e-learning portals**
- **https://chem.libretexts.org/Courses/University_of_California_Davis/Chem_4C_Lab%3A_General_Chemistry_for_Majors/Chem_4C%3A_Laboratory_Manual/05%3A_Potentiometric_Titrations_(Experiment)**
- **https://vlab.amrita.edu/?sub=2&brch=191**
- **https://www.orgsyn.org/**

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
End Semester Exam(ESE):35Marks

Continuous Internal Assessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- **05** Total Marks -**15**	Better marks out of thetwo Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **P. Performed the Task based on lab. work - 20 Marks** **Q. Spotting based on tools& technology (written) – 10 Marks** **R. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

Indira

DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with research)*			Semester - VII	Session: 2024-25
1	Course Code	CHSC-07T		
2	Course Title	INORGANIC & PHYSICAL CHEMISTRY-II		
3	Course Type	DSC		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *Study the formation, stability and electronic spectra of complexes* ➢ *Analyze the chemistry of metal carbonyls and metal nitrosyls.* ➢ *Solve the Schrodinger equation for the hydrogen atom and utilize Huckel theory for conjugated systems.* ➢ *Analyze collision theory and transition state theory to understand chemical reactions.*		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**MOT & Electronic Spectra of Complexes** Electronic spectra and MO theory of Transition Metal complexes , M.O. Theory for octahedral, tetrahedral and square planar complexes with and without π-bonding Determining the Energy terms, Spin-orbit (L-S) coupling scheme, Hund's rule for term symbol, Hole formalism, Determination of the term symbol (ground and excited states) for d 1 to d 9 configurations, Electronic spectra of transition metal complexes, Types of transitions, Laporte 'orbital' selection rule, spin selection rule. Orgel diagrams for octahedral metal complexes. Charge transfer spectra, Racah parameters, calculations of 10Dq, B, β parameters. Tanabe- Sugano Diagrams of octahedral complexes with d 2 and d8 configuration.	12
II	**Metal – Ligand Equilibria** A) Metal – Ligand Equilibria in Solution: Stepwise and overall formation constants; trends in stepwise formation constants; factors affecting stability of metal complexes with reference to nature of metal ion, ligand, chelate effect and thermodynamic origin. Determination of formation constant by: (1) spectrophotometric method (Job's and Mole ratio method) (2) Potentiometric method (Irving-Rossotti Method) B) **Reaction Mechanism of Transition metal complexes**-: Energy Profile of a reaction, reactivity of metal complexes, Inert and Labile complexes, Kinetics of Octahedral substitution C) **Metal carbonyls**: vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls. Metal carbonyl clusters with reference to classification, synthesis and structures. D) **Metal nitrosyls**: Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and X-ray diffraction studies of transition metal nitrosyls for bonding and structure elucidation.	11
III	**Advanced Quantum Mechanics** Discussion of solutions of the Schrodinger equation to three - dimensional box, concept of degeneracy, the harmonic oscillator, the rigid rotor, the hydrogen atom. **Approximate Methods**	11

	The variation theorem and perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to hydrogen and helium atom. **Angular Momentum** Ordinary angular momentum, eigen functions and eigen values of angular momentum, ladder operator, concept of spin, antisymmetry and Pauli's exclusion principle. **Molecular Orbital Theory** Huckel theory of conjugated systems, Applications to ethylene, butadiene and cyclobutadiene.	
IV	**Advanced Chemical Dynamics** **A)** Methods of determining rate laws, Temperature dependence of chemical reaction rates, Arrhenius equation, Energy of activation, pre-exponential factor and its limitations, Collision theory and its limitations, steric factors, Transition State theory of gas and liquid phase bimolecular reactions, comparison of three theories of reaction rates, kinetic salt effects. Kinetics of Photochemical reactions (Hydrogen-bromine and hydrogen - chlorine reactions). **B)** Bodeinstein steady state approximation and its application in consecutive reactions, Dynamics of unimolecular reactions :Lindeman-Hinshelwood mechanism, RRKM theory, Thermodynamic formulation of transition state theory, Enthalpy, Gibbs free energy and enthalpy of activation.	**11**
Keywords	***Electronic spectra, MO theory, Complex stability, Spectrophotometry, Vibrational spectra, Bonding, Metal nitrosyls, Schrodinger equation, Huckel theory , Collision theory, Transition state theory***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Bali, R. (2014). Principles of inorganic chemistry (5th ed.). New Age International.*
2. *Prasad, R. K. (2012). Quantum mechanics (3rd ed.). New Age International.*
3. *Puri, B. R., Sharma, L. R., & Rastogi, V. D. (2012). A textbook of physical chemistry. Vishwa Prakashan.*
4. *Rakshit, P. C. (2014). Elements of physical chemistry. S. Chand & Company.*

Reference Books Recommended:-

1. *Lee, J. D. (2008). Inorganic chemistry (4th ed.). Wiley India.*
2. *Greenwood, N. N., & Earnshaw, A. (2012). Chemistry of the elements (2nd ed.). Elsevier.*
3. *Laidler, K. J. (1987). Chemical kinetics (3rd ed.). Pearson Education.*
4. *Cotton, F. A., Wilkinson, G., Boch, P. L., & Bailar, M. Bailar Jr. (2018). Inorganic chemistry (6th ed.). John Wiley & Sons.*
5. *Mathews, P. M., & McFarlane, F. W. (2014). A textbook of quantum mechanics (2nd ed.). Mc Graw Hill Education.*
6. *Houston, P. L. (2001). Chemical kinetics and reaction dynamics. Dover Publications.*

Online Resources–

- https://nptel.ac.in/courses/115106066
- https://nptel.ac.in/
- https://onlinecourses.nptel.ac.in/noc23_cy02/preview
- https://swayam.gov.in/

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

Indira Bohra

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honor/Honors with Research)*			**Semester - VII**	Session: **2024-2025**
1	**Course Code**	**CHSC-07P**		
2	**Course Title**	**CHEMISTRY LAB. COURSE-VII**		
3	**Course Type**	**DSC**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *Master separating and estimating acidic and basic radicals in inorganic mixtures.* ➢ *Apply qualitative and quantitative analysis skills to real samples. • Inorganic Synthesis & Characterization* ➢ *Gain hands-on experience synthesizing inorganic compounds and identify them using spectral analysis.* ➢ *Grasp basic physical chemistry concepts through practical experiments and learn to operate basic equipment.*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Qualitative analysis of mixture containing eight radicals including two less common metals from among the following by semi micro method.** **Basic Radicals:** Ag, Pb, Hg Bi, Cu, Cd, As, Sb, Sn, Fe, Al, Cr, Zn, Mn, Co, Ni, Ba, Sr, Ca, Mg, Na, K, Ce, Th, Zr, W, Te, Ti, Mo, U, V, Be, Li, Au, Pt. **Acidic Radicals:** Carbonate, Sulphite, Sulphide, Nitrite, Nitrate, Acetate, Fluoride, Chloride, Bromide, Iodide, Sulphate, Borate, Oxalate, Phosphate, Silicate, Thiosulphate, Ferricyanide, Sulphocyanide, Chromate, Arsinate and Permanganate. **Separation and determination of two metal ions in ores, alloys, or mixtures in solution, one by volumetric and the other by gravimetric methods.** **Estimations** (a) Phosphoric acid in commercial orthophosphoric acid. (b) Boric acid in borax. (c) Ammonia in an ammonium salt. (d) Manganese dioxide in pyrolusite. (e) Available chlorine in bleaching powder. (f) Hydrogen peroxide in a commercial sample. **Preparations** Preparation of selected inorganic compounds and their study by I.R. Electronic spectra, Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds. Theoretical study of structure and their identification of some preparations by spectral analysis	**30**

1. $VO(acac)_2$
2. $TiO(C_9H_8NO)_2 2H_2O$
3. Cis-K $[Cr(C_2O_4)_2(H_2O)_2]$
4. $Na[Cr(NH_3)_2(SCN)_4]$
5. $Mn(acac)_3$
6. $K_3[Fe(C_2O_4)_3]$
7. Prussian Blue, Turnbull's Blue.
8. $[Co(NH_3)_6][Co(NO_2)_6]$
9. Cis-$[Co(trien)(NO_2)_2]Cl.H_2O$
10. $Hg[Co(SCN)_4]$
11. $[Co(Py)_2Cl_2]$
12. $[Ni(NH_3)_6]Cl_2$
13. $Ni(DMG)_2$
14. $[Cu(NH_3)_4]SO_4.H_2O$

Adsorption

1. To study surface tension – concentration relationship for solution (Gibb's equation).
2. To study the adsorption of oxalic acid on charcoal and to verify Freundlich adsorption isotherm.

Chemical Kinetics

1. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
2. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.

Polarimetry

1. Determine the specific and molecular rotation of optically active substance.
2. To determine the concentration of a solution of an optically active substance.

Solutions

1. Determination of molecular weight of non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
2. Determination of molecular weight of non-volatile substances by Landsberger's method.

Spectrophotometry

1. Verification of Beer-Lambert law and determination of concentration of unknown solution.
2. Effect of pH in aqueous coloured system.

Potentiometry/pH metry

1. Determination of temperature dependence of EMF of a cell.
2. To determine pKa of the given monobasic acid by pHmetric titration.
3. Determination of the dissociation constant of monobasic/dibasic acid by Albert- Serjeant method.

Keywords	***Qualitative Analysis, Separation and Determination, Estimations, Preparations, Spectroscopic Techniques, Adsorption, Chemical Kinetics, Polarimetry, Solutions, Instrumental Methods***

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended

1. *Das, R. C., & Behra, B. (2009). Experimental Physical Chemistry (1st Ed.). Tata Mcgraw-Hill Education.*
2. *Chatwal, G. R., & Sharma, A. (2019). Instrumental Methods of Chemical Analysis. Himalaya Publishing House.*

Reference Books Recommended

1. *Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (1974). Vogel's Textbook of Qualitative Chemical Analysis (5th Ed.). ELBS.*
2. *Jolly, W. L. (1970). Synthesis and Characterization of Inorganic Compounds. Prentice Hall.*
3. *James, A. M., & Prichard, F. E. (1981). Practical Physical Chemistry (4th Ed.). Longman.*
4. *Plevitt, B. (1974). Findlay's Practical Physical Chemistry (9th Ed.). Longman.*

Online Resources–

- **(https://www.wiley.com/en-us/Microscale+Inorganic+Chemistry%3A+A+Comprehensive+Laboratory+Experience-p-9780471619963)**
- **(https://onlinelibrary.wiley.com/doi/book/10.1002/9780470405840)**
- **(https://www.amazon.com/Physical-Chemistry-Molecular-Donald-McQuarrie/dp/0935702997)**
- **(https://www.amazon.com/Laboratory-Manual-Physical-Chemistry-Davison/dp/1297998979)**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **S. Performed the Task based on lab. work - 20 Marks** **T. Spotting based on tools & technology (written) – 10 Marks** **U. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**CHSC-08T**		
2	**Course Title**	**ORGANIC & INORGANIC CHEMISTRY-II**		
3	**Course Type**	**DSC**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***Master mechanisms, kinetics, mechanism and reactivity factors in organic chemistry.*** ➢ ***Understand and predict regioselectivity in aromatic electrophilic substitution reactions.*** ➢ ***Utilize symmetry and group theory to analyze molecules and predict spectroscopic features.*** ➢ ***Understand and classify supramolecular chemistry***		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**MECHANISTIC ORGANIC CHEMISTRY** Unit I: A) Reaction mechanism: Types of reaction, Types of mechanism, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, trapping of intermediates, checking for common intermediate, competition and cross-over experiments, isotope effects, Hard and soft acids and bases. B) Reaction Kinetics: Reaction co-ordinate diagrams, rate laws and methods of determining concentration. C) Effect of Structure on reactivity: Resonance and field effects, Steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft Equation. D) Aromatic electrophilic substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The o/p ratio, ipso attack, orientation in benzene ring with more than one substituent, orientation in another ring system. Friedel-Crafts reaction, Vilsmeir-Hack reaction, Gatterman-Koch reaction, Pechman reaction, Diazonium coupling, Blanc chloromethylation, Kolbe– Schmitt reaction	12
II	**SUBSTITUTION REACTIONS** A) Aliphatic nucleophilic substitution: The SN1, SN2, mixed SN1, SN2 and SET and SNi mechanisms. Nucleophilicity, effect of leaving group, ambient nucleophiles and ambient substrates regiospecificity, substitution at allylic and vinylic carbon atoms, Mitsunobu reaction B) Concept of neighbouring group participation: Anchimeric assistance with mechanism, neighboring group participation by π and σ bonds, classical and non-classical carbocations, Intramolecular displacement by hydrogen, oxygen, nitrogen, sulphur and halogen. Alkyl, cycloalkyl, aryl participation, participation in bicyclic system, migratory aptitude. C) Aromatic Nucleophilic Substitution: A general introduction to different mechanisms of aromatic nucleophilic substitution SNAr, SN1, benzyne and SRN1 mechanisms,	11

	arynes as reaction intermediate, Reactivity - effect of substrate structure leaving group and attacking nucleophile. The Von Richter and Smiles rearrangements, Chichibabin amination reaction. Benzyne: Structure, methods of generations and reactions	
III	**Symmetry and Group Theory in Chemistry** Symmetry elements and symmetry operation, definition of group, subgroup, relation between order of a finite group and its subgroup. Conjugacy relation and classes. point symmetry group. Schonflies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh} etc. groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their uses in spectroscopy.	**11**
IV	**Supramolecular Chemistry:** Concepts and language, Molecular recognition Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of coreceptor molecules and multiple recognition. Supramolecular reactivity and catalysis. **Transport processes and carrier design.** Supramolecular devices. Supramolecular photochemistry, Supramolecular electronic, ionic and switching devices. Some examples of self-assembly in supramolecular chemistry. **Metal Clusters:** Higher boranes, carboranes, metalloboranes and metallocarboranes, compounds with metal-metal multiple bonds. **Isopoly and Heteropoly Acids and Salts.**	**11**
Keywords	***Reaction mechanisms, kinetics, regioselectivity, electrophilic substitution, substitution mechanisms, neighboring group participation, symmetry, group theory, supramolecular chemistry***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended -

Textbooks Recommended

1. *Soni, P. L., Bahl, B. S., & Bahl, A. (2019). Organic Chemistry.S. Chand & Company Ltd.*
2. *Morrison, R. T. & Boyd, R. N. (2012). Organic Chemistry. Pearson Education.*
3. *Kumar, A. (2004). Elements of Group Theory for Chemists. New Delhi, India: Affiliated East-West Press.*
4. *Mukherji, S. M. & Chakrabarti, S. P. (2007). Reaction Mechanisms in Organic Chemistry. Macmillan India Ltd.*

Reference Books Recommended

1. *Carey, F. A. & Sundberg, R. J. (2007). Advanced Organic Chemistry. Springer.*
2. *Ahluwalia, V. K. & Aggarwal, R. (2010). A Textbook of Organic Chemistry. Narosa Publishing House.*
3. *Carruthers, W. (1987). Modern Organic Synthesis. Springer.*
4. *Smith, M. B. & March, J. (2006). March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure. John Wiley & Sons.*
5. *Grossman, R. B. (2004). The Art of Writing Reasonable Organic Reaction Mechanisms. Oxford University*

Online Resources–

- https://onlinecourses.nptel.ac.in/noc20_cy30/preview
- https://swayam.gov.in/
- https://www.coursera.org/
- https://www.edx.org/
- https://onlinecourses.nptel.ac.in/noc20_cy30/preview

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:		
Maximum Marks:	**100 Marks**	
Continuous Internal Assessment (CIA):	**30 Marks**	
End Semester Exam (ESE):	**70 Marks**	
Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**CHSC-08P**		
2	**Course Title**	**CHEMISTRY LAB. COURSE-VIII**		
3	**Course Type**	**DSC**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *To understand the basic principles involved in separation of organic binary mixture and identify the components by qualitative analysis.* ➢ *To get trained in one step/two-step synthesis of commercially important organic compounds based on different chemical processes.* ➢ *To learn about separation and purification of organic mixtures by chromatography* ➢ *To identify and characterize prepared and separated compounds by IR spectral analysis.*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**Organic Synthesis** (i) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography. (ii) Synthesis of β-Naphthyl acetate / Hydroquinone diacetate. (iii) Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol (iv) Grignard reaction: Synthesis of triphenylmethanol from benzoic acid (v) Aldol condensation: Dibenzalacetone from benzyldehyde (vi) Sandmeyer reaction: p-chlorotoluene from p-toluidine / o-chlorobenzoic acid from anthranilic acid. (vii) Acetoacetic ester Condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation. (viii) Cannizzaro reaction: 4- chlorobenzaldehyde as substrate / Benzoic acid and benzyl alcohol. (ix) Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene. (x) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and bromoaniline. (xi) Clemmenson reduction: Hydrocarbons from ketones. (xii) Nitration: Picric acid from phenol (xiii) Reduction: Acetic acid from ethanol. (xiv) Esterification: Oil of Wintergreen from salicylic acid. (xv) Sulphonation: Sulphanilic acid from aniline. **Separation, purification and identification of compounds of binary mixtures (solid-solid, liquid-solid) using chemical tests.** Identification of functional group of organic compounds by FTIR Separation, purification and identification of compounds of binary mixtures TLC	**30**

	and column chromatography.	
Keywords	*Organic Synthesis, Separation techniques (column chromatography, TLC), Identification techniques (FTIR), Volumetric analysis, Chromatography (paper, column), Flame photometry, Spectrophotometry (UV-Vis), Conductometry, pH-metry.*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Basavarajaiah, S. M., Nagesh, G. Y., & Ramakrishna Reddy, K. (2016). *Compendious Practical Organic Chemistry: Preparations, Isolation, and Chromatography*. New Age International.
2. Manna, A. K. (2011). *Practical Organic Chemistry*. Books & Allied (Publishers) Pvt. Ltd.
3. Peesapati, V. (2017). *Practical Organic Chemistry – A Primer*. BSP Books.

Reference Books Recommended:

1. Vogel, A. I. (**1957**). *Practical Organic Chemistry*. Longman Scientific & Technical.
2. Mann, F. G., & Saunders, B. C. (**2004**). *Practical Organic Chemistry* (4th Ed.). Longman.
3. Jeffery, G. H., Mendham, J., Denney, R. C., & Barnes, J. (**2000**). *Vogel's Textbook Of Quantitative Chemical Analysis* (6th Ed.). Longman.
4. Harris, D. C. (**1998**). Quantitative Chemical Analysis (5th Edition). W H Freeman & Co

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **(https://www.wiley.com/en-us/Microscale+Inorganic+Chemistry%3A+A+Comprehensive+Laboratory+Experience-p-9780471619963)**
- **(https://onlinelibrary.wiley.com/doi/book/10.1002/9780470405840)**
- **(https://www.amazon.com/Physical-Chemistry-Molecular-Donald-McQuarrie/dp/0935702997)**
- **(https://www.amazon.com/Laboratory-Manual-Physical-Chemistry-Davison/dp/1297998979)**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **V. Performed the Task based on lab. work - 20 Marks** **W. Spotting based on tools & technology (written) – 10 Marks** **X. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelor in Science (Diploma / Degree/Honors)		Semester - III	Session: 2024-2025
1	Course Code	CHSE-01T	
2	Course Title	BASIC ANALYTICAL CHEMISTRY	
3	Course Type	DSE	
4	Pre-requisite(if,any)	*As per Program*	
5	Course Learning Outcomes(CLO)	➢ *To understand the sampling, procedure and treatment of sample.* ➢ *To understand the analytical techniques for analysis in different types of chemical reactions.* ➢ *To understand the volumetric analysis technique.* ➢ *To understand the gravimetric analysis technique.*	
6	Credit Value	3 Credits	*Credit = 15 Hours -learning & Observation*
7	Total Marks	Max.Marks: 100	Min Passing Marks:40

PART -B: Content of the Course

Total No. of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No. of Period
I	**Qualitative and quantitative aspects of analysis** Classification of analytical Techniques, Qualitative and quantitative analysis. Classical and instrumental methods. Factors affecting choice of analytical method. Errors in chemical analysis. Types of errors: Systematic and random, Absolute and relative, Additive and proportional. Normal distribution of indeterminate errors. Statistical parameters for data evaluation: Mean, median, average deviation, standard deviation, coefficient of variation, relative standard deviation. Accuracy and precision of results. Comparison of data using F and t-test, rejection of data using Q test. Numerical problems.	12
II	**Sampling and sample treatment** Criteria for representative sample. Bulk, gross, incremental and analysis sample. Sampling statistics. Techniques of sampling of ambient air, water and soil samples. Methods of sample size reduction: Coning and quartering, rolling and quartering. Hazards in sampling. Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion, fusion processes and dissolution of organic samples. Types of analysis: Macro, semi-micro, micro, sub-micro and ultramicro. Major, minor and trace constituents of a sample.	11
III	**Volumetric analysis** General principle. Criteria for reactions used in titrimetric analysis. Primary standards and secondary standards. Concepts of equivalent weight and molecular weight, normality, molarity and various methods of expressing concentrations. Internal and external indicators. Theories of indicators in acid-base, precipitation, redox and complexometric titrations. Calculations involving preparation of standard solutions. Stoichiometric calculations in various types of titrations.	11
IV	**Gravimetric analysis** General principles and conditions of precipitation. Concepts of solubility, solubility product and precipitation equilibrium. Numerical problems based on solubility and solubility product. Purity of precipitate: Co-precipitation and post-precipitation. Super saturation and peptization. Criteria of selection of wash liquids. Steps involved in gravimetric analysis of barium as barium sulphate.	11

Keywords	*Qualitative and quantitative analysis;errors;Accuracy;Sampling;titrimetric analysis;indicators;Gravimetric analysis*

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Pandey, O. P., Bajpai, D. N., Giri, S., Shrivastava, B. B. L., & Mishra, A. (2010). Practical chemistry (1st ed.). S. Chand & Company.*
2. *Shrivastava, B. B. L., & Mishra, A. ([Year]). Fundamentals of analytical chemistry.*

Reference books Recommended:

1. *Harris, D. C. (2000). Quantitative chemical analysis W. H. Freeman and Company.*
2. *Mikes, O., & Chalmers, R. A. (2007). Laboratory handbook of chromatographic methods Elsevier.*
3. *Christian, G. D., Dasgupta, P. K., & Snyder, S. (2001). Concepts of instrumental analysis , Oxford University Press.*

Online Resources:

- **https://edu.rsc.org/resources/analysis**
- **https://guides.loc.gov/chemistry-resources/print-materials/analytical**
- **https://www.classcentral.com/course/swayam-analytical-techniques-13896**
- **https://www.technic.com/analytical-controls/capabilities/volumetric-analysis**
- **https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/General_Chemistry_Labs/Online_Chemistry_Lab_Manual/Chem_11_Experiments/07%3A_Gravimetric_Analysis_(Experiment)**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 100 Marks
ContinuousInternal Assessment(CIA):30 Marks
EndSemesterExam(ESE): 70 Marks

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment/Seminar- **10** Total Marks **-30**	Better marks out of the two Test / Quiz**+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit- **4x10=40Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Diploma / Degree/Honors)*			**Semester- III**	Session: **2024-2025**
1	**Course Code**	**CHSE-01P**		
2	**Course Title**	**BASIC ANALYTICAL CHEMISTRY LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite**(if,any)	*As per Program*		
5	**Course Learning. Outcomes(CLO)**	➢ *To make the student aware of Common analytical method.* ➢ *To demonstrate the volumetric titration.* ➢ *To demonstrate the students about gravimetric analysis.* ➢ *To learn the testing of solubility, pH of soil and water.*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**TotalMarks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content of the Course

Total No. of learning-Training/performance Periods:30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture by volumetric titration. 2. Estimation of oxalic acid by titrating it with $KMnO_4$ (potassium permanganate) by volumetric titration. 3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$ (potassium permanganate). 4. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ (potassium dichromate) using an internal indicator. 5. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$ (sodium thiosulfate). 6. Determination of heat capacity of a calorimeter for different volumes. 7. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 8. Determination of ionization of acetic acid. 9. Determination of solubility of benzoic acid in water and determination of enthalpy of solubilization. 10. Analysis of soil: (a) Determination of pH of soil. (b) Determination of total soluble salts. (c) Determination of carbonate and bicarbonate. (d) Determination of calcium, magnesium, and iron.	**30**
Keywords	***Volumetric analysis, gravimetric analysis, water testing, soil testing.***	

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Chatwal, G. R., & Sharma, A. (2017). Instrumental methods of chemical analysis. Himalaya Publishing House.*
2. *Sharma, L. R. (2021). Practical inorganic chemistry.*
3. *Fernelius, W. G. (2009). Experimental inorganic chemistry (Adapted by R. K. Sharma & G. Panda). New Age International Publishers.*
4. *Yadava, T. F. (2010). A textbook of soil chemistry. Kalyani Publishers.*

Reference Books Recommended:

1. *James, A. M., & Prichard, F. E. (1981). Practical physical chemistry (3rd ed, repr). Longman. Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (Eds.). (2000). Vogel's textbook of quantitative chemical analysis (6th ed.). Pearson Education India. (Original work by A. I. Vogel)*
2. *Svehla, G. (Ed.). (1978). A textbook of quantitative inorganic analysis (by A. I. Vogel). ELBS Publishers and Distributors.*

Online Resources:

- **https://swayam.gov.in/explorer**
- **https://in.indeed.com/career-advice/career-development/analytical-skills**
- **https://chemcollective.org/labtech**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- 05 Total Marks -**15**	Better marks out of thetwo Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks

End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener& Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Diploma /Degree/Honors)*			**Semester–IV**	Session: **2024-2025**
1	**Course Code**	**CHSE-02T**		
2	**Course Title**	**ENVIRONMENTAL CHEMISTRY**		
3	**Course Type**	**DSE**		
4	**Pre-requisite(if, any)**	***As per Program***		
5	**Course Learning Outcomes(CLO)**	➢ ***To explore the environment through the lens of chemistry, examining interactions between the biosphere, lithosphere, hydrosphere, and atmosphere.*** ➢ ***To delve into ecological principles, biogeochemical cycles, and the challenges of thermal and noise pollution.*** ➢ ***To develop concept of water quality, water management, and the multifaceted issue of water pollution take center stage.*** ➢ ***To investigate air pollution, soil composition, radiation chemistry, and potential solutions for environmental challenges.***		
6	**Credit Value**	**03 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max.Marks:100**		**Min. PassingMarks:40**

PART-B: Content of the Course

Total No.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Module /Unit	Topics(Course contents)	No.of Period
I	**Introduction to Environmental Chemistry** Biosphere, Lithosphere, Hydrosphere and Atmosphere, Ecological principles- aspects of ecology, classification, types of ecosystems. Biogeochemical cycles- carbon, nitrogen, phosphorous, oxygen, hydrogen. Thermal pollution: sources, harmful effects, and prevention of thermal pollution. Noise pollution: sources, effects, and control of noise pollution.	12
II	**Water** Origin, physico-chemical properties of water, sources of water, hydrological cycle, criteria of water quality, Water management- water shed management, rainwater harvesting, water pollution- sources, consequences and harmful effects of water pollution, strategies for water pollution control.	11
III	**Air** Major regions of the atmosphere, composition of the atmosphere, temperature inversion and air pollution episodes, photochemistry of the atmosphere, depletion of the stratospheric ozone, greenhouse effect, greenhouse gases, remedial measures for reversion of greenhouse effect, acid rain, photochemical smog, particulate matter.	11
IV	**Soil and radiation pollution** Chemical and mineralogical composition of soil, classification of soil, types of soil-saline and alkaline, physical properties – texture, bulk density, permeability, chemical properties—Ion exchange capacity, soil pH and micro and macro nutrient availability. Introduction to radiation chemistry, sources of radioactive pollution, effects of radioactive pollution, protection from radiation, control of radiation.	11
Keywords	***Environment, Chemistry, Atmosphere, Hydrosphere/Biosphere/lithosphere, Biogeochemical cycles, water, water management, Air, Acid rain, Photochemical smog, Greenhouse gases,***	

	Particulate matter, Soil and radiation pollution, Radiation Chemistry.

Signature of Convener & Members (CBoS) :

PART–C

Learning Resources: Text books, Reference Books and Others

Textbooks Recommended–

1. *Dara, S. S. (2002). Environmental chemistry. New Delhi: S Chand & Company Ltd.*
2. *De, A. K. (2003). Environmental chemistry. New Delhi: New Age International.*
3. *Mahajan, (2010). Environmental chemistry. New Delhi: S Chand & Company Ltd.*
4. *Kudesia, V. P. (1985). Water pollution. Pragati Prakashan.*

Reference Books Recommended–

1. *Chiras, D. D. (1994). Environmental science (4th ed.). Jones & Bartlett Learning.*
2. *Bockris, J. O. M. (1977). Environmental chemistry. Academic Press.*
3. *Lodge, J. P. (1994). Methods of air sampling and analysis. Publications, Jaipur.*
4. *Moore, W., & Moore, J. (2010). Environmental chemistry. CRC Press.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://ncert.nic.in/textbook/pdf/kech207.pdf
- https://archive.nptel.ac.in/courses/122/106/122106030/
- https://scienceinfo.com/environmental-chemistry-definition-importance-application-and-careers/
- https://www.ncbi.nlm.nih.gov/books/NBK83730/
- https://ebooks.inflibnet.ac.in/esp16/chapter/water-pollution/#:~:text=The%20amount%20of%20dissolved%20oxygen,dissolved%20oxygen%20than%20saline%20water.
- https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_-_The_Central_Science_(Brown_et_al.)/18%3A_Chemistry_of_the_Environment
- https://byjus.com/chemistry/environmental-chemistry/
- https://www.nrdc.org/stories/water-pollution-everything-you-need-know#whatis

Part-D:AssessmentandEvaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**

Continuous Internal Assessment(CIA): **30 Marks**

EndSemester Exam(ESE): **70 Marks**

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 &20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam(ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks.**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Diploma / Degree/Honors)*			**Semester - IV**	Session: **2024-2025**
1	**Course Code**	**CHSE-02P**		
2	**Course Title**	**ENVIRONMENTAL CHEMISTRY LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	-		
5	**Course Learning Outcomes (CLO)**	➢ *To know the basic idea on techniques of water analysis and acidity alkalinity* ➢ *To get experience with the calculations of BOD and COD* ➢ *To understand the basics of soil analysis viz. pH, Conductivity.* ➢ *To have an experience on the determination of heavy metals in soil and Colorimetric estimation of iron and manganese.* ➢ *To familiarize with interpretation of data*		
6	**Credit Value**	**01Credit**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max.Marks:50**	**Min. Passing Marks:20**	

PART-B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course.	**Water Analysis** a. Alkalinity b. Acidity c. Temporary, Permanent and total hardness d. Sulphate e. Phosphorus	**30**
	Water analysis e. Nitrites f. Chlorides g. D.O, BOD and COD h. Insecticides i. Pesticides Analysis of chemicals used in water and waste water treatment-Alum, bleaching powder, activated carbon. Determination and comparison of chlorine content in tap water, storage tank and swimming pool.	
	Soil Analysis Determination of: a. pH b. Conductivity c. Ca d. Mg e. Heavy metals like Cr, Pb, Cd, Zn.	
	Miscellaneous Analysis of nutrients – Nitrogen (total, ammonia,nitrite, and nitrate), Phosphate Determination of N,P,K of soil	

	Determination of macro and micro nutrients in soil. Sampling of water- tap water, well water, overhead storage tank water pond water and lake water. Physicochemical and organoleptic characteristics of the above water samples. Statistical evaluation of the data obtained for optimization of results. Determination of Total solids, Total dissolved solids and total suspended solids and its significance. Determination of noise pollution in a particular area with noise dosimeter. Study of particulate matter. Study of atmospheric chemistry. Air Monitoring Gas detection.
Keywords	***Sampling, Water, soil, N/P/K, pH, Conductivity, acidity & alkalinity, Heavy metals.***

Signature of Convener & Members (CBoS) :

PART–C

Learning Resources: Text Books, Reference Books andOthers

Textbooks Recommended–

1. *Dara, S. S., & Asole, B. G. (2017). Environmental chemistry: Practical approach (2nd ed.). New Age International (India) Publishers.*
2. *Trivedi, R. K., Goyal, P., & Trisal, B. S. (2018). Manual of water and wastewater analysis (2nd ed.). ABD Publishers & Distributors.*
3. *Sehgal, H. S. (2010). A textbook of soil chemical analysis (2nd ed.). Kalyani*

Reference Books Recommended–

1. *Vogel, A. I. (1955). A text-book of quantitative inorganic analysis: theory and practice. Longmans,*
2. *Green and Company.*
3. *Sandell, E. B. (1945). Colorimetric determination of traces of metals (Vol. 59, No. 6, p. 481). LWW.*
4. *Boubel, R. W., Vallero, D., Fox, D. L., Turner, B., & Stern, A. C. (2013). Fundamentals of air*
5. *pollution. Elsevier.*
6. *Clesceri, L. S. (1998). Standard methods for examination of water and wastewater. American public*
7. *health association, 9.*
8. *Rump, H. H. (1999). Laboratory manual for the examination of water, waste water and soil (No. Ed. 3). Wiley-VCH Verlag GmbH.*

OnlineResources– e-Resources/e-booksande-learningportals

- https://ncert.nic.in/textbook/pdf/kech207.pdf
- https://archive.nptel.ac.in/courses/122/106/122106030/
- https://scienceinfo.com/environmental-chemistry-definition-importance-application-and-careers/
- https://www.ncbi.nlm.nih.gov/books/NBK83730/
- https://ebooks.inflibnet.ac.in/esp16/chapter/water-pollution/#:~:text=The%20amount%20of%20dissolved%20oxygen,dissolved%20oxygen%20than%20saline%20water.
- https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_-_The_Central_Science_(Brown_et_al.)/18%3A_Chemistry_of_the_Environment
- https://byjus.com/chemistry/environmental-chemistry/
- https://www.nrdc.org/stories/water-pollution-everything-you-need-know#whatis
- https://www.envirotech-online.com/news/gas-analyser/157/envea/portable-multi-gas-analyser-gains-qal1-certification-for-so2/60799.

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **D. Performed the Task based on lab. work - 20 Marks** **E. Spotting based on tools & technology (written) – 10 Marks** **F. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Degree/Honors)*			**Semester- V**	Session: **2024-2025**
1	**CourseCode**	**CHSE-03T**		
2	**CourseTitle**	**DYES & POLYMER CHEMISTRY**		
3	**CourseType**	**DSE**		
4	**Pre-requisite(if,any)**	*As per Program*		
5	**Course Learning. Outcomes(CLO)**	➢ *To know about various synthetic dyes and their structures.* ➢ *To understand classification, colour and chemical constitution of dyes.* ➢ *To know about various types of polymeric materials.* ➢ *To understand preparation, structure, properties and application of polymers.*		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours -learning & Observation*	
7	**TotalMarks**	**Max.Marks:**	**100**	**Min Passing Marks:40**

PART -B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No.ofPeriod
I	**Introduction to dyes:** Requirements of a good dye Solubility, Linearity, Co-planarity, Fastness, Substantivity, Economic viability. Definition of fastness and its properties and Mordants with examples Explanation of nomenclature or abbreviations of commercial dyes with at least one example suffixes – G, O, R. Naming of dyes by colour index (two examples) used in dye industries. **Colour and chemical constitution of dyes:** Absorption of visible light, colour o wavelength absorbed and complementary colour, chromogen, chromophore, auxochrome bathochromic and hypsochromic shifts. Relation of colour to resonance in the followin classes of dyes: Azo, Triphenylmethane, Anthraquinone.	12
II	**Classification of dyes based on application:** Definition, fastness properties and applicability on substrates, examples with structures. (a) Acid dyes – Orange II, Alizarin Cyanine Green G. (b) Basic dyes – Crystal Violet, Bismark Brown. (c) Direct Cotton Dyes – Chrysophenine G. (d) Azoic dyes – Diazo components: Fast Red B Base, Fast Blue B Base; Coupling components: Naphthol AS, Naphthol AS-G. (e) Mordant dyes – Eriochrome Black T, Alizarin. (f) Vat dyes – Indigo, Indanthrene (g) Disperse dyes– Celliton Scarlet B, Disperse Yellow 6G	11
III	**Introduction and history of polymeric materials:** Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. **Functionality and its importance:** Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.	11
IV	**Determination of molecular weight of polymers** (*Mn,Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index **Brief introduction to preparation, structure, properties and application**: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride), polyamides and related polymers, Phenol formaldehyde resins (Bakelite, Novalac), Conducting Polymers,	11

	[polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].	
Keywords	***Average molecular mass, PDI, Dyes, Polymer, diazodyes, bismarkbrown,Vat dyes,indigo dyes.***	

SignatureofConvener&Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Bhatnagar, M. S. (2010). A textbook of polymer chemistry. S. Chand & Company.*
2. *Misra, G. S. (2004). Introductory polymer chemistry. New Age International Publishers & Distributors.*
3. *Gowariker, V. R., Vishvanathan, N. V., & Sreedhar, J. (2008). Polymer science. New Age International Publication.*

Reference Books Recommended:

1. *Braun, D., Cherdron, H., Rehahm, M., Ritter, H., & Voit, B. (Year). Polymer synthesis: Theory and practice: fundamental method experiments (5th ed.). Springer.*
2. *Vogel, A. I. (Year). A textbook of Organic Chemistry including Qualitative Organic Analysis. Longman Publication.*
3. *Mann, F. G., & Saunders, B. C. (Year). Organic Chemistry. Pearson Publications.*

Online Resources–

- **e-Resources / e-books and e-learning portals**

- **https://onlinecourses.nptel.ac.in/noc22_cy53/preview**
- **https://nptel.ac.in/courses/116104044**
- **http://ndl.iitkgp.ac.in/he_document/swayam_prabha/1tcmcnbo3sk**
- **http://www.ndl.gov.in/he_document/swayam_prabha/cyvucrniwcq**

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
End Semester Exam(ESE):70 Marks

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20+20** Assignment/Seminar- **10** Total Marks -**30**	Better marks out of the two Test / Quiz+ obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit- **4x10=40Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Degree/Honors)*			**Semester-V**	Session: **2024-2025**
1	**Course Code**	**CHSE-03P**		
2	**Course Title**	**DYES AND POLYMER CHEMISTRY LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite(if,any)**	***As per Program***		
5	**Course Learning Outcomes(CLO)**	➢ To learn the synthesis of organic dyes in laboratory. ➢ To learn the synthesis of common drugs. ➢ To learn the synthesis of polymer. ➢ To make aware the student about polymer in our day to day life.		
6	**CreditValue**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**TotalMarks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content of the Course

Total No.of learning-Training/performance Periods:30 Periods (30 Hours)

Module	Topics (Course contents)	No.of Period
Lab./Field Training/ Experiment Contents of Course	1. Synthesis of organic compound or dyes:- Methyl orange(azo coupling) phenolphthalein, Methyl red, Cango red, Fluorecein, Alizarin 2. Synthesis of drugs: Paracetamol, aspirin, sulphanilamide, Chlorobutanol, Tolbutamide, hexamine, 3. Synthesis of Some polymer or project work on some polymer: polyvinyl alcohol, Rayon,PVC,Nylon6, silicon based inorganic polymer, silicone, zeolite 4. Project work of identification of polymer around us in day to day life	**30**
Keywords	***Synthesis of organic compound, Crude test, Limit test, Pharmaceutical Packaging.***	

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books:

1. *Gupta, V. R., Kumar, R., & Gupta, A. (Year). Organic Chemistry. I. K. International Publishing House.*
2. *Bansal, R. K. (Year). Industrial Organic Chemistry. New Age International Publishers.*
3. *Kar, A. (Year). Medicinal Chemistry. New Age International Publishers.*
4. *Jain, A. K. (Year). Introduction to Pharmaceutical Chemistry. Pharma Book Publications.*
5. *Ghosh, B. (Year). Polymer Chemistry. New Age International Publishers.*
6. *Sinha, U. C., & Sinha, N. K. (Year). Polymer Science. Oxford University Press.*

Reference Books:

1. Braun, D., Cherdron, H., Rehahm, M., Ritter, H., & Voit, B. (Year). Polymer synthesis: Theory and practice: fundamental method experiments (5th ed.). Springer.
2. Vogel, A. I. (Year). A text book of Practical Organic Chemistry including Qualitative Organic Analysis. Longman Publication London.
3. Mann, F. G., & Saunders, B. C. (Year). Practical Organic Chemistry. Pearson Publications.
4. Burrell, H. (Year). Polymer Analysis. John Wiley & Sons.
5. Griffiths, R. F. (Year). Identification of Polymers. John Wiley & Sons.

Online Resources:

- **https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/Organic_Chemistry_Labs/Experiments/1%3A_Synthesis_of_Aspirin_(Experiment)**
- **https://edu.rsc.org/experiments/the-microscale-synthesis-of-azo-dyes/559.article#:~:text=In%20this%20experiment%2C%20students%20prepare,practical%20should%20take%2020%20minutes.**
- **https://www.scribd.com/doc/36584645/Polymers-Chemistry-Project**

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- 05 Total Marks **-15**	Better marks out of thetwo Test / Quiz **+**obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **G. Performed the Task based on lab. work - 20 Marks** **H. Spotting based on tools& technology (written) – 10 Marks** **I. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(/ Degree/Honors)*			**Semester - VI**	Session: **2024-2025**
1	**Course Code**	**CHSE-04T**		
2	**Course Title**	**HETEROCYCLIC CHEMISTRY**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***- As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***To apply Hantzsch-Widman and IUPAC nomenclature for heterocyclic compounds.*** ➢ ***To understand the concept of tautomerism in aromatic heterocycles and to analyze the influence of strain on small ring heterocycles.*** ➢ ***To learn the synthesis and reactions of three-, four-, five- and six-membered heterocycles with one heteroatom.*** ➢ ***To learn the synthesis of important bicyclic heterocycles (indole, quinoline, and isoquinoline) and learn the mechanisms of reactions.***		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Nomenclature and Stereochemistry** Introduction to heterocyclic compounds, Trivial names of common ring systems Hantzsch-Widman nomenclature for: Monocyclic heterocycles, Fused heterocycles Bridged heterocycles Replacement of Hantzsch-Widman nomenclature by IUPAC nomenclature	11
II	**Tautomerism and Strain in Heterocycles** Tautomerism in aromatic heterocycles The effect of strain: Bond angle strain Torsional strain Consequences of strain in small ring heterocycles **Three- and Four-Membered Heterocycles** Synthesis and reactions of: Aziridines, Oxiranes (epoxides), Thiiranes, Azetidines Oxetanes, Thietanes	11
III	**Five- and Six-Membered Heterocycles with One Heteroatom** Preparation and properties (chemical and physical) of: Pyrroles (including Paal-Knorr synthesis, Knorr pyrrole synthesis, and Hantzsch synthesis), Furan, Thiophene Pyridine (including Hantzsch synthesis) **V. Five-Membered Heterocycles with Two Heteroatoms** Preparation, properties, and Substitution reactions of: Pyrazoles, Imidazoles, Oxazoles	11
IV	**Bicyclic Heterocycles: Reactions and Synthesis** Indole (including Fischer indole synthesis and Madelung synthesis) Quinoline and isoquinoline (including Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, and Pomeranz-Fritsch reaction) Reactions of bicyclic heterocycles: Mechanisms of electrophilic and nucleophilic substitutions, Oxidation and reduction reactions	12
Keywords	***Heterocyclic Chemistry, Nomenclature, Tautomerism, Strain, Rings, Synthesis, Reactions, Bicyclic hetrocycles,***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books Recommended

1. *Gupta, R.R., Kumar, M., & Gupta, V. (Eds.) (1984). Heterocyclic Chemistry (Vol. 1-3). Springer Verlag.*
2. *Arora, M. K. (2009). Heterocyclic chemistry. New Age International Publishers.*

Reference Books Recommended

1. *Acheson, R.M. (1961). An Introduction to the Heterocyclic Compounds. John Wiley.*
2. *Katritzky, A.R., & Rees, C.W. (Eds.) (1984). Comprehensive Heterocyclic Chemistry. Pergamon Press.*
3. *Joule, J.A., Mills, K., & Smith, G.F. (2010). Heterocyclic Chemistry. Wiley-Blackwell.*
4. *Gilchrist, T.L. (1992). Heterocyclic Chemistry. Pearson Education Limited.*

Text Books Recommended -

Online Resources–

- **e-Resources / e-books and e-learning portals**

- https://www.masterorganicchemistry.com/
- https://docs.chemaxon.com/display/lts-helium/functions-by-categories.md
- https://archive.catalog.arizona.edu/faculty/courses/001/chem.html
- https://www.organic-chemistry.org/
- https://www.sciencedirect.com/org/journal/journal-of-heterocyclic-chemistry
- https://www.wiley.com/en-us/Heterocyclic+Chemistry%2C+5th+Edition-p-9781405133005
- https://www.amazon.com/Chemistry-Heterocycles-Structures-Reactions-Applications/dp/3527327479
- https://www.wiley.com/en-us/Name+Reactions+in+Heterocyclic+Chemistry-p-9780471302155

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Degree/Honors)*			**Semester - VI**	Session: **2024-2025**
1	**Course Code**	**CHSE-04P**		
2	**Course Title**	**HETEROCYCLIC CHEMISTRY LAB. COURSE I**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***Proficient in basic laboratory techniques like distillation, extraction, crystallization, and chromatography.*** ➢ ***Skilled in the synthesis and purification of heterocyclic compounds.*** ➢ ***Adept at using various spectroscopic techniques (IR, NMR, MS) to characterize heterocyclic structures.*** ➢ ***Able to analyze reaction mechanisms and predict product formation in heterocyclic reactions.***		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**Synthesis and Characterization of a Simple Pyridine Derivative:** This experiment will involve the synthesis of a pyridine derivative (e.g., 2-aminopyridine, 2,6-dimethylpyridine(Hantzsch-syntheis) or nicotinamide) followed by purification (recrystallization/distillation) and characterization using melting point, thin-layer chromatography (TLC). **Synthesis and Characterization of a Five-Membered Heterocycle (e.g., Imidazole, Pyrazole, Furan):** Students will synthesize an 2,5 dimethyl pyrrole(Paal-Knorr synthesis) imidazole, pyrazole derivative using a condensation reaction. Purification (distillation/recrystallization) and characterization using techniques like melting point , TLC. **Synthesis and Characterization of a Benzofused Heterocycle** This experiment experiment will involve the synthesis of Coumarins, Coumarone, 2-Phenylindole, Indigo(Dye) **Isolation of Caffeine from Tea Leaves:** This practical involves the extraction and purification of caffeine (a purine derivative) from tea leaves. Techniques like solvent extraction, filtration, and sublimation might be employed. **Identification of Unknown Heterocycle:** Students will be presented with an unknown heterocyclic compound and utilize various spectroscopic techniques (IR, NMR, mass spectrometry) to identify the functional groups and propose the structure of the unknown molecule.	**30**
Keywords	***Synthesis, Characterization, Heterocycles, Techniques, TLC, IR, Extraction, Isolation***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Ahluwalia, V. K., & Aggarwal, R. (2000). Comprehensive practical organic chemistry: Preparations and quantitative analysis, Universities Press*

Reference Books Recommended –

1. *Miller, J. R., & Friswell, M. D. (2000). Organic Chemistry Laboratory Techniques. Pearson Education Limited.*
2. *Mohrig, J., Garland, T. L., & Hammond, P. C. (2022). Techniques and Experiments in Organic Chemistry. W. H. Freeman and Company*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- (https://www.cas.org/)
- (https://www.youtube.com/channel/UCEWpbFLzoYGPfuWUMFPSaoA)
- (https://ocw.mit.edu/courses/chemistry/)

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks
Continuous Internal Assessment (CIA): 15 Marks
End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **J. Performed the Task based on lab. work - 20 Marks** **K. Spotting based on tools & technology (written) – 10 Marks** **L. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Honors/Honors with Research)*			**Semester VII**	Session: **2024-2025**
1	**CourseCode**	**CHSE-05T**		
2	**CourseTitle**	**PHOTOCHEMISTRY AND PERICYCLIC REACTION**		
3	**CourseType**	**DSE**		
4	**Pre-requisite(if,any)**	*As per Program*		
5	**Course Learning. Outcomes(CLO)**	➢ *To study the photochemical reaction and pericyclic reaction* ➢ *To gain knowledge about mechanism of light induced reaction.* ➢ *To learn the mechanism of thermal reaction* ➢ *To understand the difference between light and thermal reaction.*		
6	**CreditValue**	**3 Credits**	*Credit = 15 Hours -learning & Observation*	
7	**TotalMarks**	**Max.Marks: 100**		**Min Passing Marks:40**

PART -B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Coursecontents)	No.ofPeriod
I	**Photochemical reactions and Reaction Mechanism** Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecules, quantum yield, transfer of excitation energy, actinometry. Classification, rate constants and life times of reactive energy states - determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions – Photo-oxidation, photo-reduction, photo-dissociation, gas phasephotolysis.	12
II	**Photochemistry of Alkenes** Intramolecular reactions of the olefinic bond - geometrical isomerism, cyclisation reactions, photochemical rearrangement of alkenes,rearrangement 1, 4- and 1,5-dienes. **Photochemistry of Aromatic Compounds:** Photochemical isomerization of aromatic compounds, Photochemical addition and substitutions reactions shown by aromatic compounds.	11
III	**Photochemistry of Carbonyl Compounds** Photochemical reactions of carbonyl compounds: Norrish type I and II reactions Intramolecular reactions of carbonyl compounds - saturated cyclic and acyclic, β, γ - unsaturated and α, β - unsaturated compounds. Cyclohexadienones. Intermolecular cycloaddition reactions –photo-dimerisation reaction and oxetane formation. **Miscellaneous Photochemical Reactions** Photo-Fries reactions of anilides. Photo-Fries rearrangment. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.	11
IV	**Pericyclic Reactions** Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3- butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffman correlation diagrams. FMO and PMO approach. Electrocyclic reactions- conrotarory and	11

	disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions- antarafacialand suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes.Sigmatropic rearrangements, suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3, 3-and 5,5- sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements.	
Keywords	***Photochemical reaction, thermal reaction,***	

SignatureofConvener&Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Singh, J., & Singh, J. (n.d.).* ***Photochemistry and pericyclic reactions****. [Publisher not provided].*
2. *Gupta, A. L. (2024).* ***Photochemistry****. Pragati Prakashan (7th Edition).*

Reference books Recommended:

1. *Ramamurthy, V., & Schanze, K. S. (1999).* ***Organic photochemistry****. Taylor & Francis.*
2. *Wardle, B. (2000).* ***Principles and applications of photochemistry****. John Wiley & Sons.*

Online Resources–

- **https://nptel.ac.in/courses/104105038**
- **https://archive.nptel.ac.in/courses/104/106/104106077/**
- **https://www.scribd.com/document/512848351/Photochemistry-and-Pericyclic-Reactions-by-J-Singh**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 100 Marks
ContinuousInternal Assessment(CIA):30 Marks
EndSemesterExam(ESE):70 Marks

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment/Seminar- **10** Total Marks -**30**	Better marks out of the two Test / Quiz+ obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit- **4x10=40Marks**	

NameandSignatureofConvener&MembersofCBoS:

Indira

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester VII**		Session: **2024-2025**
1	**CourseCode**	**CHSE-05P**		
2	**CourseTitle**	**PHOTOCHEMISTRY& PERICYCLIC REACTION LAB. COURSE**		
3	**CourseType**	**DSE**		
4	**Pre-requisite(if,any)**	-		
5	**Course Learning. Outcomes(CLO)**	➢ *To learn the advanced organic chemistry concept that will applied in solving their future chemistry problems.* ➢ *To learn about arenium ion ,classical versus non classical carbonium ion ,different rearrangement reactions* ➢ *To make student aware the level of basic organic chemistry to apply in different reaction mechanisms and organic transformations.*		
6	**CreditValue**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**TotalMarks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content oftheCourse		
TotalNo.of learning-Training/performancePeriods:30 Periods (30 Hours)		
Module	**Topics(Coursecontents)**	**No.ofPeriod**
Lab./Field Training/ Experiment Contents of Course	1. Synthesis of organic compound involving important chemical reaction:- (a)Acetylations salicylic acid, aniline, glucose and hydroquinone, (b) Benzoylation of aniline and phenol. (c) Aliphatic electrophilic substitution: preparation of iodoform from ethanol and acetone (d) Arromatic electrophilic substitution: nitration-preparation of meta dinitrobenzene, p-nitroacetinalide, halogenation: preparation of p-bromoaetanilaide,2,4,6-tribromophenol. (e) Diazotisation/ coupling :- Preparation of methyl orange and methyl red, (f)Oxidation: Preaparation of benzoic acid from toluene (g) Reduction: Preparation of aniline from nitrobenzene, m-nitroanilene from m-dinitrobenzene. 2. Isolation of some natural products(casein from milk, lycopene from tomato, nicotine from tobacco leaves etc.) 3. Detection of element, functional group and organic compound.	**30**
Keywords	***Synthesis of organic compound, functional group test. Lassagne test.***	

Signature of Convener& Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text books Recommended:

1. *Bansal, R. K. (1994).* ***Laboratory manual of organic chemistry****. New Age International Publishers.*
2. *Vogel Textbook of Practical Organic Chemistry 5th edition, Pearson Publication.*

Reference books Recommended:.

1. *Vishnoi, N. K. (2010).* ***Advanced practical organic chemistry*** *(3rd ed.). Vikas Publishing House.*
2. *Saikia, B. (Year).* ***Organic chemistry-I with practical..***
3. *Agrawal, O. P. (Year).* ***Advanced practical organic chemistry****. Krishna Publication.*

Online Resources:

https://www.organic-chemistry.org/synthesis/

https://www.orgsyn.org/

https://vlab.amrita.edu/?sub=2&brch=191&sim=344&cnt=1#:~:text=In%20order%20to%20detect%20them,detected%20by%20simple%20chemical%20tests.

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- 05 Total Marks **-15**	Better marks out of thetwo Test / Quiz **+**obtained marks in Assignment shall be considered against **15** Marks

End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **M. Performed the Task based on lab. work - 20 Marks** **N. Spotting based on tools& technology (written) – 10 Marks** **O. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

Indira

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Degree/Honors)*			**Semester - VII**	Session: **2024-2025**
1	**Course Code**	**CHSE-06T**		
2	**Course Title**	**SPECTROSCOPY-I**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***To equips students with advanced spectroscopic techniques for in-depth molecular analysis.*** ➢ ***To enable classification, isotope effect analysis, and vibrational energy calculations of techniques like microwave and infrared spectroscopy*** ➢ ***To provide detailed information on structure, environment, and electronic configuration on advanced methods like NMR, NQR, and PES.*** ➢ ***To allows students to probe chemical and surface properties of materials using Photoacoustic spectroscopy.*** ➢		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Molecular Spectroscopy** Energy levels, molecular orbital, vibronic transitions, vibration progressions and geometry of the excited states, Franck - Condon principle, electronic spectra of polyatomic molecules. Emission spectra: radiative and non-radiative decay, internal conversion, spectra of transition metal complex, charge transfer spectra. **Microwave Spectroscopy** Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field. Applications.	12
II	**Infrared spectroscopy** Review of linear harmonic oscillator, vibrational energy of diatomic molecules, zero point energy, force constant and bond strengths, anharmonicity. Morse potential energy diagram, vibration – rotation Spectroscopy, P, Q, R branches. Breakdown of Oppenheimer approximation, vibration of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal ligand vibrations, normal co-ordinate analysis. **Raman Spectroscopy** Classical and quantum theories of Raman effect – Pure rotational, vibrational and vibrational–rotational Raman spectra, selection rules, mutual exclusion principle. Resonance Raman Spectroscopy, coherent anti stokes Raman Spectroscopy (CARS)	11
III	**Nuclear Magnetic Resonance Spectroscopy** Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift,	11

	deshielding, spin- spin interactions, factors including coupling constant 'J'. Classification (ABX, AMX, ABC, AB etc), spin decoupling. Basic ideas about instruments, FT NMR, advantages of FT NMR, use of NMR in medical diagnostics. **Nuclear Quadruple Resonance Spectroscopy** Quadruple nuclei, Quadruple moments, electric field gradient, coupling constant, splitting, applications.	
IV	**Photoelectron Spectroscopy** Basic principle: photo-electric effect, ionization process, Koopmans theorem, photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. **Photo acoustic Spectroscopy** Basic principles of photo acoustic spectroscopy (PAS), PAS gases and condensed systems, chemical and surface applications. **Electron Spin Resonance Spectroscopy** Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications.	**11**
Keywords	***Electronic Transitions, Emission Spectra, Isotope Effect, Vibrational Energies, Raman Spectroscopy, Nuclear Magnetic Resonance (NMR), Nuclear Quadrupole Resonance (NQR), Photoelectron Spectroscopy (PES), Photoacoustic Spectroscopy (PAS), Molecular Structure***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Muthu, K. S. (2010). Applications of spectroscopy. Medtech Publications.*
2. *Ambika, Dr., & Singh, P. P. (2017). Organic spectroscopy. Viva Books.*

References Books Recommended –

1. *Hollas, J. M. (2019). Modern Spectroscopy (John Wiley & Sons).*
2. *Applied Electron Spectroscopy For Chemical Analysis (Wiley-Interscience).*
3. *Parish, R. V. (1983). NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry (Ellis Horwood).*
4. *Drago, R. S. (1977). Physical Methods in Chemistry (Saunders Company).*
5. *Nakamoto, K. (2009). Infrared and Raman Spectra: Inorganic and Coordination Compounds (Wiley).*
6. *Williams, D. H., & Fleming, I. (2010). Spectroscopic Methods in Organic Chemistry (Tata Mcgraw-Hill).*
7. *Dyer, J. R. (1975). Application of Spectroscopy of Organic Compounds (Prentice Hall).*

Online Resources–

- **e-Resources / e-books and e-learning portals**

Online Resources–

- **(https://archive.nptel.ac.in/courses/104/106/104106122/**
- **(https://m.youtube.com/watch?v=o8zELwp358A**
- **https://archive.nptel.ac.in/courses/103/108/103108139/)**
- **(https://nptel.ac.in/courses/104108078)**

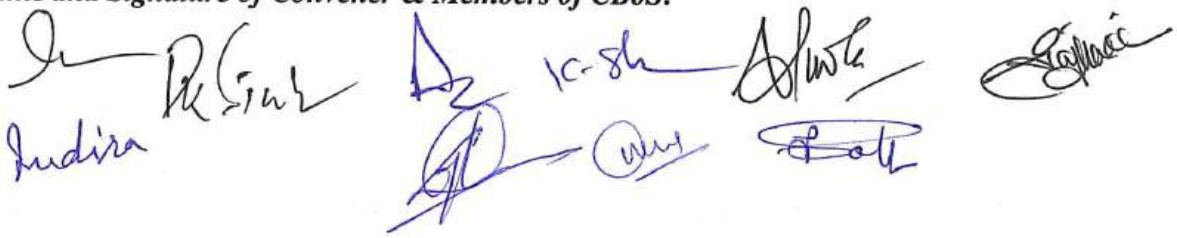
PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester - VII**	Session: **2027-2028**
1	**Course Code**	**CHSE-06P**		
2	**Course Title**	**SPECTROSCOPY-I LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***Understand the fundamental principles of different spectroscopic techniques (Microwave, Infrared, Raman, NMR, UV-Vis (optional) and interpret the data obtained from various spectroscopic experiments.*** ➢ ***Relate the observed spectroscopic features to the structure, bonding, and dynamics of molecules.*** ➢ ***Develop practical skills in operating spectroscopic instrumentation and analyzing data.*** ➢ ***Enhance critical thinking and problem-solving skills in a laboratory setting.***		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Rotational Spectroscopy of a Diatomic Molecule (Microwave Spectroscopy):** Analyze the rotational spectrum of simple molecules and calculate its moment of inertia. **Infrared (IR) Spectroscopy of a Simple Molecule:** Record and interpret the IR spectrum of a molecule, identifying functional groups based on characteristic frequencies. **Raman Spectroscopy of a Liquid Sample:** Compare the Raman spectrum of a liquid to its IR spectrum and explore the concept of mutual exclusion principle. **Nuclear Magnetic Resonance (NMR) Spectroscopy of Simple Molecules:** Analyze the ^{1}H NMR spectrum of simple organic molecule, understanding the effects of chemical environment and spin-spin coupling. **(Ultraviolet-Visible (UV-Vis) Spectroscopy of a Conjugated System: Concentration Determination of Using Lambert Beer's Law,** measurement of the UV-Vis spectrum of a chromophore-containing molecule (e.g., conjugated diene, transition metal complex) and analyze the observed absorption bands based on their λ_{max} (wavelength of maximum absorption) values, Investigate the electronic transitions of a conjugated molecules (polyenes and conjugated carbonyls) using UV-Vis spectroscopy, study the formation of a colored complex in a complexation reaction, Calculation of the equilibrium constant using Beer's Law and relevant equations. **ESR:** Common examples include studying free radicals generated during chemical reactions or analyzing organic radicals in biological systems.	**30**

Keywords	*Electronic Transitions, Emission Spectra, Raman Spectroscopy, Nuclear Magnetic Resonance (NMR), Electron Spin Spectroscopy (ESR), UV-Visible Spectroscopy*

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Mukherjee, P. S. (2009). *Electronic Absorption Spectroscopy and Related Techniques* (1st Ed.). New Age International (Publishers).
2. Sharma, Y. R. (2007). *Elementary organic spectroscopy* (Reprint). S. Chand Publishing.
3. Yadav, D. S. (2004). *Organic spectroscopy*. [Kindle Edition]. doi: 10.1007/978-1-4020-2575-4

Reference Books:

1. Smith, R. A. (1974). *Infrared and Raman Spectra of Inorganic Compounds*. CRC Press.
1. Abraham, R. J., & Settle, F. A. (2011). *Interpreting NMR Spectra*. Wiley-Blackwell.
2. Jaffe, H. H., & Orchin, M. (1962). *UV-Vis Spectral Library of Common Organic Molecules*. Prentice-Hall.
3. Carnevale, A., & Piacenti, P. (2017). *Experimental Techniques in Nuclear Magnetic Resonance Spectroscopy*. Royal Society of Chemistry.
4. Chalmers, J. M., & Griffiths, P. R. (2002). *Handbook of Vibrational Spectroscopy*. John Wiley & Sons, Ltd.

Online Resources–

- **e-Resources / e-books and e-learning portals**

- (https://www.nist.gov/)
- (https://edu.rsc.org/resources/spectroscopy-videos/1041.article)
- (https://acsanalytical.org/)
- (https://nscl.msu.edu/)
- (https://new.nsf.gov/funding/opportunities/nsf-national-quantum-virtual-laboratory-nqvl)
- (https://www.chemtube3d.com/sym-operationsrotations/)

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **P. Performed the Task based on lab. work - 20 Marks** **Q. Spotting based on tools & technology (written) – 10 Marks** **R. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Honors/Honors with Research)*		Semester–VII		Session:2024-25
1	CourseCode	CHSE-07T		
2	CourseTitle	CHEMICAL KINETICS AND NUCLEAR CHEMISTRY		
3	CourseType	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	CourseLearning. Outcomes(CLO)	➢ *To understand types/kinetics of composite reactions and elucidate mechanism and derive rate laws, calculate various activation parameters and predict feasibility of reaction of its basis.* ➢ *To explain the concept of acidity functions and illustrate the various rate correlations, isotopic effect and solvent effect.* ➢ *To discuss various aspects of nuclear models, nuclear reactions and nuclear reactors.* ➢ *To understand the principles of radioactivity, its measurements, counters, apply in determining reaction mechanism, structures, physicochemical properties and in chemical analysis.*		
6	CreditValue	03Credits	*Credit = 15 Hours - learning & Observation*	
7	TotalMarks	Max.Marks:100		MinPassingMarks:40

PART-B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Coursecontents)	No.of Period
I	**Kinetics of CompositeReactions** Types of composite mechanism, rate equation for composite mechanisms-simultaneous and consecutive reactions, microscopic reversibility, some inorganic mechanisms- formation and decomposition of phosgene, decomposition of nitrogen pentoxide and ozone and thermal para-ortho hydrogen conversion. **Kinetics of Catalytic Reactions** Kinetics of acid-base catalysis: general and specific, hydrolysis of ester and amide; Enzyme catalysis, Micellar catalysis. **Activation Parameters** Activation parameters from experimental results- Arrhenius factor, standard free energy of activation, standard enthalpy of activation, entropy of activation and their physical significance.	12
II	**Acidity function and various rate correlations** Hammett acidity function, various treatments of rate correlation, Linear Free Energy Relationship (LFER), The Hammett equation, Zucker-Hammett hypothesis, Bunnett-Olsen parameter. **Isotopic Effect** Theory of isotopic effects; Primary and secondary kinetic isotope effects. Heavy atom isotope effects, Tunneling effect. Kinetic solventeffects. **Solvent Effect** Qualitative theory of influence of solvent on reaction rate; Solvent effect in terms of dielectric constant, Grunwald - Weinstein parameter, Z and E values. Application of solvent polarity, Koppel - Palmtreatment.	11

III	**Nuclear Models** Shell model – magic numbers, salient features and merits; liquid drop model – analogy with liquid drop, merits, semi-empirical equation; Fermi gas model; collective model and opticalmodel. **Nuclear Reactions** Nuclear fusion and fission; Nuclear fission – mass, energy and charge distribution of fission products; fission neutrons; liquid drop model. **Nuclear Reactors** Natural uranium reactors, classification of reactors – typical reactors, Breeder reactor.	11
IV	**Radioactivity** General characteristics of radioactive decay and decay kinetics, measurement of radioactivity: Ionization chamber, electron pulse counters – variation of pulse size with voltage, Geiger-Muller counter, proportional counter and scintillation counters. **Applications of Radioactivity** Typical applications of radioisotopes as tracers; chemical investigation – reaction mechanism and structure determination; physicochemical applications – solubility of sparingly soluble and surface area of a powder; analytical applications – isotope dilutionanalysisand neutron activation analysis; age determination and medical applications.	11
Keywords	***Kinetics, composite reactions, catalytic reactions, activation parameters, acidity function, isotopic effect, nuclear models, radioactivity.***	

Signature of Convener & Members (CBoS):

PART–C

LearningResources:Textbooks,ReferenceBooksandOthers

Textbooks Recommended–

1. Arnikar, H. J. (1995). *Essentials of nuclear chemistry* (No. 1653). New Age International.

Reference Books Recommended–

1. Laidler, K. J., & Keith, J. (1965). *Chemical kinetics* (Vol. 2). New York: McGraw-Hill.
2. Chorkendorff, I., & Niemantsverdriet, J. W. (2017). *Concepts of modern catalysis and kinetics*. John Wiley & Sons.
3. Vannice, M. A., & Joyce, W. H. (2005). *Kinetics of catalytic reactions* (Vol. 134). New York: Springer.Investigation of Reduction Rates and Mechanism of Reactions. Edward Lewis.

OnlineResources–e-Resources/e-booksande-learningportals

- **https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_-_The_Central_Science_(Brown_et_al.)/14%3A_Chemical_Kinetics/14.S%3A_Chemical_Kinetics_(Summary)**
- **https://www.vssut.ac.in/lecture_notes/lecture1425072667.pdf**
- **https://www.khanacademy.org/science/chemistry/chem-kinetics/arrhenius-equation/a/types-of-catalysts**
- **https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch103-allied-health-chemistry/ch103-chapter-3-radioactivity/**
- **https://www.orano.group/en/unpacking-nuclear/all-about-radioactivity**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 &20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/ Honors with Research)*		**Semester - VII**		Session: **2024-2025**
1	**CourseCode**	**CHSE-07P**		
2	**CourseTitle**	**CHEMICAL KINETICS AND NUCLEAR CHEMISTRY LAB. COURSE**		
3	**CourseType**	**DSE**		
4	**Pre-requisite(if,any)**	*As per Program*		
5	**Course Learning Outcomes(CLO)**	➢ *To understand basic concepts in Physical Chemistry through experiential learning.* ➢ *To acquaint with the basic principles of equipment/instruments and its applications.* ➢ *To determine the order of reaction with respect to various reactants and overall order and activation parameters using experimental data.* ➢ *To acquire the knowledge of radioactive decay and GM counter.*		
6	**Credit Value**	**01Credit**	*(Credit = 30 Hrs laboratory or Field learning / training)*	
7	**Total Marks**	**Max.Marks:50**	**MinPassingMarks:20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Chemical Kinetics** 1. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions. 2. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction. **Polarimetry** 1. Determine the specific and molecular rotation of optically active substance. 2. To determine the concentration of a solution of an optically active substance. **Viscosity** 1. To determine viscosity of an organic liquid using Ostwald viscometer. 2. To verify Kendall's equation. 3. To study the variation of viscosity with temperature. 1. To study the effect of concentration of the reactant and catalysts on the rate of hydrolysis of ester. 2. To study the effect of temperature, concentration of the reactant and catalysts on the rate of hydrolysis of ester and to calculate energy of activation, frequency factor, enthalpy of activation, entropy of activation and free energy of activation.	**30**

	3. To study the kinetics of saponification of ethyl acetate by (a)Volumetric method (b) Conductometric method 4. To study the influence of ionic strength on the reaction between potassium persulphate and iodide. 5. To study the Kinetics of reaction between H_2O_2 and KI. 6. To study the kinetics of reaction between sodium formate and iodine. 7. To study the kinetics of reaction between acetone and iodine. 8. To determine the rate constant of hydrolysis / inversion of sugar using polarimeter and factors effecting. 9. To study some simple enzyme catalysed reaction. 10. To determine plateau and optimal operating voltage of Geiger-Muller counter. 1. To determine the dead time or resolving time of GM counter. 2. Simulation of Radioactive decay using rolling of dice.	
Keywords	***Chemical Kinetics, nuclear chemistry, Activation energy,GM counter, Decay kinetics***	

Signature of Convener &Members (CBoS):

PART–C

LearningResources:TextBooks,ReferenceBooksandOthers

Textbook Recommended-

1. *Athawale, V. D., & Oza, N. R. (2001). Experimental physical chemistry. New Age International Publishers.*
2. *Bahl, B. S., Bahl, A., & Tuli, G. D. (2018). Essentials of physical chemistry (Vol. 2: Practical physical chemistry). S. Chand Publishing.*

Reference Books Recommended

1. *Friedlander, G., Kennedy, J. W., Miller, J. M., Seaborg, G. T., & Nuclear Regulatory Commission. (2014). **Radiochemistry and nuclear chemistry** (Vol. 2: Practical radiochemistry).*

OnlineResources–

https://www.mdpi.com/books/reprint/4856-synthesis-and-characterization-of-nanomaterials
https://swayam.gov.in
https://epathshala.nic.in
http://as.wiley.com/WileyCDA/WileyTitle/productCd-EHEP000803.html

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam(ESE):	**Laboratory/Field Skill Performance : on spot Assessment** **A: Perform task Based on the lab work- 20 Mark** **B: Spotting Based on tools and techniques- 10 marks** **C: Viva-voce (Based on principle/technology)-05 Marks**	**Managed by Course teacher as per Lab. Status.**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Certificate/Diploma /Degree/Honors)*			Semester–VII	Session:2024-2025
1	CourseCode	CHSE-08T		
2	CourseTitle	ELECTRO CHEMISTRY & SURFACE CHEMISTRY		
3	CourseType	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	CourseLearning. Outcomes(CLO)	➢ *Understand electrochemistry fundamentals, explain laws and industrial applications* ➢ *To explain and derive equations related to the theory of strong electrolytes – Debye-Huckel law and its extensions, structure/models and thermodynamics of electrified interfaces, polarography and its applications.* ➢ *To describe and interpret various adsorption isotherms and its applications, concept and various aspects of micelles.* ➢ *To understand the fundamentals, types, and applications of surfactants and micelles.*		
6	CreditValue	03Credits	*Credit = 15 Hours - learning & Observation*	
7	TotalMarks	Max.Marks:100		MinPassingMarks:40

PART-B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Module /Unit	Topics(Coursecontents)	No.of Period
I	**Electrochemistry-1** Electrolyte conductance: specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch law, application of Kohlrausch law indetermination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titrations. Single electrode potential, standard electrode potential, electrochemical series and its applications. Concept of overvoltage.	12
II	Theory of strong electrolyte: limitation of Ostwald's dilution law weak and strong electrolyte, Debye-Huckel-Onsager's(DHO) equation for strong electrolytes, relaxation, and electrophoretic effect. Migration of ions: Transport number-definition and determination by Hittorf method and movingboundary method. Electrochemical cells or Galvanic cells: reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell, effect of temperature on EMF of cell, Nernst equation calculation of ΔG, ΔH andΔ S for cell reaction.	11
III	**Electrochemistry-2** Electrochemistry of solutions: Ion- solvent interactions, Debye-Huckel theory for activity coefficient of electrolyte solutions, ionic strength, Debye-Huckel limiting law, Debye- Huckel- Onsager treatment and its extension. Thermodynamics of electrified interface equations: Derivation of electro-capillarity, Lippmann equations, determination of surface excess. Structure of electrified interfaces: Guoy-Chapman and Stern models. Over	11

	potentials, exchange current density, derivation of Butler-Volmer equation. Tafel plot. Polarography theory - Ilkovic equation, half wave potential and its significance.	
IV	**Surface Chemistry** Adsorption Surface tension, capillary action, pressure difference across curved surface (Laplace equation), Gibbs adsorption isotherm, BET equation and estimation of surface area using BETequation. **Micelles** Surface active agents, classification of surface active agents, micellization, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, reverse micelles.	**11**
Keywords	***Electrochemistry, Kohlrausch law, electrode potential, standard electrode potential, electrochemical series, Debye-Huckel limiting law, surface chemistry, micelles, adsorption.***	

Signature of Convener & Members (CBoS):

PART–C

LearningResources:Textbooks,ReferenceBooksandOthers

Textbooks Recommended–

1. Soni, P. L., & Mahajan, S. N. (2013). **A textbook of physical chemistry** (Vol. 3: Electrochemistry and surface chemistry). Sultan Chand & Sons.
2. Rakshit, P. C. (2009). **A textbook of physical chemistry** (Vol. 2: States of matter). Tata McGraw-Hill Education.

Reference Books Recommended–

1. Moroi, Y. (2013). *Micelles: theoretical and applied aspects*. Springer Science & Business Media.
2. Glasstone, S. (2011). *An introduction to electrochemistry*. Read Books Ltd.
3. Plieth, W. (2008). *Electrochemistry for materials science*. Elsevier.
4. Bikerman, J. J. (2013). *Surface chemistry: theory and applications*. Elsevier.
5. Somorjai, G. A., & Li, Y. (2010). *Introduction to surface chemistry and catalysis*. John Wiley & Sons.

OnlineResources–e-Resources/e-booksande-learningportals

- https://ceramrtr.ceramika.agh.edu.pl/~szyszkin/eis/Modern%20Electrochemistry%20Vol%202B%20Electrodics%20in%20Chemistry,%20Engineering.pdf
- https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCYA5303.pdf
- https://www.genesis-tutorials.com/wp-content/uploads/2018/04/Surface-chemistry.pdf
- https://study.com/academy/lesson/micelles-biology-structure-function.html

Part-D:Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**

Continuous Internal Assessment(CIA): **30 Marks**

EndSemester Exam(ESE): **70 Marks**

Continuous InternalAssessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 &20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam(ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks.**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester - VIII**		Session: **2024-2025**
1	**CourseCode**	**CHSE-08P**		
2	**CourseTitle**	**ELECTROCHEMISTRY AND SURFACE CHEMISTRY LAB. COURSE**		
3	**CourseType**	**DSE**		
4	**Pre-requisite(if,any)**	*As per Program*		
5	**CourseLearning.Outcomes(CLO)**	➢ *To acquire the knowledge of surface tension* ➢ *To apply the principle of conductance in studying different applications.* ➢ *To apply various concepts of Physical Chemistry and use instruments in studying various applications.* ➢ *To acquire the surface tension – concentration relationship for solution*		
6	**CreditValue**	**01Credit (Practical)**	*(Credit = 30Hrs laboratory or Field learning / training)*	
7	**TotalMarks**	**Max.Marks:50**		**MinPassingMarks:20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics(Coursecontents)**	**No.of Period**
Lab./Field Training/ Experiment Contents of Course	**Conductometry** Estimation of aspirin from tablet. Determination of relative strengths of different acids. Determination of the strength of strong and weak acids in a given mixture conductometrically. **Potentiometry/pH metry** Determination of temperature dependence of EMF of a cell. To determine pK_a of the given monobasic acid by pH metric titration. Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method. **Surface Tension:** Determination of CMC of Surfactants by (1) Surface Tension method (2) Conductometric method To study surface tension – concentration relationship for solution (Gibb's equation). To study the adsorption of oxalic acid on charcoal and to verify Freundlich adsorption isotherm. To determine the parachor of the given liquid. Compare CMC of different surfactants by surface tension method.	**30**
Keywords	Conductometry, potentiometry, pH-metry,CMC	

SignatureofConvener&Members (CBoS):

PART–C
LearningResources:TextBooks,ReferenceBooksandOthers
Textbook Recommended 1. *Athawale, V. D., & Oza, N. R. (2001). Experimental physical chemistry. New Age International Publishers.*
OnlineResources– ➢ **SWAYAM https://swayam.gov.in** ➢ **e-Pathshala https://epathshala.nic.in**

Part-D:AssessmentandEvaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 50 Marks** **Continuous Internal Assessment (CIA): 15 Marks** **End Semester Exam (ESE): 35 Marks**		
Continuous Internal Assessment (CIA): **(By Course Teacher)**	**Continuous Internal Assessment (CIA):** **(By Course Teacher)**	Better marks out of two Test/Quiz + obtained marks in assessment shallbe consideredagainst 15Marks
End Semester Exam(ESE):	**Laboratory/Field Skill Performance : on spot Assessment** **A: Perform task Based on the lab work- 20 Mark** **B: Spotting Based on tools and techniques- 10 marks** **C: Viva-voce (Based on principle/technology)-05 Marks**	**Managed by Course teacher as per Lab. Status.**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Honors/Honors with Research)*		**Semester–VIII**		Session:**2024-25**
1	**Course Code**	**CHSE-09T**		
2	**Course Title**	**APPLICATION OF SPECTROSCOPY -II**		
3	**Course Type**	**DSE**		
4	**Pre-requisite(if,any)**	***As per Program***		
5	**Course Learning. Outcomes(CLO)**	➢ *To interpret the vibrational spectra of molecules to identify functional groups and understand their bonding modes.* ➢ *To gain proficiency in analyzing NMR and ESR spectra to determine the structure and electronic environment of atoms within a molecule.* ➢ *To equip students with the ability to utilize Mössbauer spectroscopy for the characterization of iron-containing materials, analyzing their oxidation state and local environment.* ➢ *To develop the skills to interpret mass spectra, including fragmentation patterns, to determine the molecular weight and structure of unknown compounds.*		
6	**Credit Value**	**03Credit**	***Credit = 15 Hours - learning & Observation***	
7	**TotalMarks**	**Max.Marks:100**		**MinPassingMarks:40**

PART-B: Content of the Course

Total No.ofTeaching–learningPeriods (01Hr.perperiod)

Module /Unit	Topics(Coursecontents)	No.of Period
I	**Vibrational Spectroscopy** Instrumentation and sample handling in IR Spectroscopy, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (Ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. FTIR. **Optical Rotatory Dispersion (ORD)and Circular Dichroism (CD)** Definition, deduction of absolute configuration, Octant rule for Ketone	12
II	**Nuclear Magnetic Resonance Spectroscopy** General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry hindered rotation. **Carbon-13 NMR Spectroscopy** General consideration, chemical shift (aliphatic, olefinic alkyne, aromatic,	11

	heteroaromatic and carbonyl carbon), coupling constants. **Two-dimension NMR Spectroscopy:** COSY, NOESY, DEPT, INEPT, APT and INADEQUATE Techniques.	
III	**Electron Spin Resonance Spectroscopy** Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron). **Mossbauer Spectroscopy** Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (2) Sn^{+2} and Sn^{+4} compounds - nature of M - L bond coordination number, structure and(3) Detection of oxidation state and inequivalent MBatoms.	**11**
IV	**Mass Spectrometry** Introduction, ion production - EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement.Nitrogenrule.High-resolution mass spectrometry.Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.	**11**
Keywords	***Vibrational Spectroscopy, Infrared Spectroscopy (IR), Nuclear Magnetic Resonance (NMR), Carbon-13 NMR, Two-Dimensional NMR (COSY, NOESY, DEPT, etc.), Electron Spin Resonance (ESR), Mössbauer Spectroscopy, Mass Spectrometry, Functional Group Identification, Organic Structure Determination***	

Signature of Convener & Members (CBoS):

PART–C

LearningResources: Textbooks, Reference Books andOthers

Textbooks Recommended

1. *Chatwal, G. R., & Sharma, A. (2017). Instrumental Methods of Chemical Analysis. Himalaya Publishing House.*
2. *Sharma, Y. R. (2000). Infrared Spectroscopy: Fundamentals and Applications. Alpha Science Agency.*
3. *Aruldhas, B. R. (2007). Nuclear Magnetic Resonance Spectroscopy. Springer.*

Reference Books Recoomended

1. *Nakamoto, K. (2009). Infrared and Raman Spectra: Inorg. and coordination compounds. Wiley.*
2. *Parish, R. V., & Ellis, H. A. (1978). NMR, NQR, EPR and Mossbauer Spectroscopy. in Inorg. Chem. Ellis Horwood.*
3. *Martin, M. L., Delpeuch, J. J., & Martin, G. J. (1982). Practical NMR Spectroscopy. Heyden.*
4. *Silverstein, R. M., Bassler, G. C., & Morrill, T. C. (1991). Spec. Identification of Org. Compd. John Wiley.*
5. *Abraham, R. J., Fisher, J., & Loftus, P. (2011). Introduction to NMR Spectroscopy. Wiley.*
6. *Dyer, J. R. (1978). Application of Spectroscopy of Organic compounds. Prentice Hall.*
7. *Williams, D. H., & Fleming, I. (1990). Spectroscopic Methods in Org. Chem. Tata McGraw Hill.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://swayam.gov.in/nd1_noc19_ch08/preview
- https://www.coursera.org/learn/spectroscopy-chemistry
- https://nptel.ac.in/courses/104/106/104106050/
- https://epathshala.nic.in/e-textbook/Class%20XI/Chemistry/ChemistryIEng.pdf

PART -D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Exam (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 ~~/20~~** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelors in Science *(Honors/Honors with Research)*			**Semester-VIII**	Session:**2024-25**
1	**Course Code**	**CHSE-09P**		
2	**Course Title**	**SPECTROSCOPY-II LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite(if,any)**	*As per Program*		
5	**Course Learning Outcomes(CLO)**	➢ *Understand working principle of FTIR instrument and interpret FTIR spectrum.* ➢ *Interpretation of H- NMR spectra, Carbon-13 NMR and ESR spectra and identifying molecules based on chemical shifts and coupling constants.* ➢ *Interpretation of Mossbauer spectra and understanding its working principle.* ➢ *Understanding working principle of mass spectrometry and interpret mass spectrum.*		
6	**Credit Value**	**01Credit**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max.Marks:50**		**MinPassingMarks:20**

PART-B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course.	**FTIR** • To prepare the KBr pellet of an organic compound (such as benzoic acid). • To carry out a qualitative analysis of an organic compound (such as benzoic acid) using FTIR. • To identify IR absorption peaks and the corresponding functional groups of an unknown solid/liquid/powder. • To study the Optical Rotatory Dispersion (ORD) of some chiral substances.	**30**
	NMR and 13CNMR • To interpret the peaks and identify molecules/structures of NMR spectrums. • To interpret the peaks and identify molecule(s)/structures of ^{13}CNMR spectrums. • To interpret the peaks and identify molecules/structures based on both NMR and ^{13}CNMR spectrums.	
	ESR and Mossbauer • To interpret the peaks and identify the magnetic character of metal/ion based on ESR spectroscopy. • To determine the resonance magnetic field B_0 as function of the selected resonance frequency (v) and the g-factor of DPPH. • To determine the line width δB_0 of the resonance signal. • To interpret and understand the Mössbauer spectra of iron Fe and Sn complexes. • To interpret the peaks (signals) and identify metal/ions based on ESR and	

	Mössbauer spectroscopy.
	Mass Spectrometry • To interpret the mass spectrum and distinguish between different molecules (e.g., alcohols/ethers, aldehydes/ketones, acids, and other aromatic molecules). • To identify the unknown molecule(s) based on combined UV-visible, FTIR, NMR and mass spectrum data.
Keywords	***Vibrational spectroscopy, FTIR, Nuclear Magnetic Resonance (NMR), ^{13}CNMR, Electron spin Resonance (ESR Spectroscopy), Mössbauer spectroscopy, Mass Spectrometry, peaks, signals.***

Signature of Convener & Members (CBoS) :

PART–C

Learning Resources:Text Books, Reference Books and Others

Textbooks Recommended–

1. *Chatwal, G. R., & Sharma, A. (2017). Instrumental Methods of Chemical Analysis. Himalaya Publishing House. Sharma,*
2. *Y. R. (2000). Infrared Spectroscopy: Fundamentals and Applications. Alpha Science Agency.*
3. *Aruldhas, B. R. (2007). Nuclear Magnetic Resonance Spectroscopy. Springer.*

Reference Books Recommended

1. *Vij, D. R. (Ed.). (2007). Handbook of applied solid state spectroscopy. Springer Science & Business Media.*
2. *Guthrie, R. D. (1979). Introduction to Spectroscopy (Pavia, Donald; Lampman, Gary M.; Kriz, George S., Jr.).*
3. *Silverstein, R. M., Bassler, G. C., & Morrill, T. C. (1991). Spec. Identification of Org. Compd. John Wiley.*
4. *Parish, R. V., & Ellis, H. A. (1978). NMR, NQR, EPR and Mossbauer Spectros. in Inorg. Chem. Ellis Horwood.*

OnlineResources– e-Resources/e-booksande-learningportals

- https://www.scribd.com/document/431879132/Lab-Report-3-CHM-260
- https://www.scribd.com/document/68027365/Electron-Spin-Resonance-Experiment
- https://www.intechopen.com/chapters/76771
- https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Magnetic_Resonance_Spectroscopies/Nuclear_Magnetic_Resonance/NMR%3A_Experimental/NMR_-_Interpretation

Part-D:AssessmentandEvaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA): 15 Marks
EndSemester Exam(ESE): 35 Marks

Continuous InternalAssessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance **-05** Total Marks - **15**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam(ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B.Spotting based on tools & technology (written) – 10 Marks** **C.Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. Status**

Signature of Convener & Members CBoS :

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Certificate/Diploma /Degree/Honors)*			Semester–VIII	Session:2024-25
1	CourseCode	CHSE-10T		
2	CourseTitle	SOLID STATE & NANOMATERIALS CHEMISTRY		
3	CourseType	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	CourseLearning. Outcomes(CLO)	➢ *Understand the origin and nature of defects and crystals, electrically conducting solids and superconductors.* ➢ *Apply the concept of band theory to explain the behavior of conductors.* ➢ *To compare bulk and nanomaterials, explain the role of size, shape, properties and uses of nanomaterials, describe various methods for synthesis of nanoparticles* ➢ *To describe the instrumentation/principle of various characterization techniques like EDAX, FTIR, SEM, TEM, etc and its application.*		
6	CreditValue	03Credits	*Credit = 15 Hours - learning & Observation*	
7	TotalMarks	Max.Marks:100		MinPassingMarks:40

PART-B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No.of Period
I	**Crystal Defects and Non-Stoichiometry** Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies - Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colourcentres, non-stoichiometry defects. **Organic Solids** Electrically conducting solids, organic charge transfer complex, organic metals, new superconductors.	12
II	**Electronic Properties and Band theory** Metals, insulators and semiconductors, electronic structure of solids – band theory, band structure of metals, insulators, and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Optical properties- Optical reflectance, photoconduction - photoelectric effects. Magnetic properties-Classification of materials: Quantum theory of paramagnetism- cooperative phenomena - magnetic domains, hysteresis.	11
III	**Introduction to Nano-materials** Properties and uses of bulk and nano-materials; Optical, electrical and magnetic properties of nano-materials; quantum confinement, role of size and shape in nano-materials. Synthesis of nano-materials Synthesis of nano-crystals by reduction, solvo-thermal synthesis, photochemical synthesis, electrochemical synthesis, semiconductor nano-particles by arrested precipitation. Synthesis of nano-particles by green routes, thermolysis routes and sono-chemical routes, sol-gel, micelle and **micro-**	11

	emulsion methods.	
IV	**Characterization of nano-materials** Instrumentation, operating principle, and application of Energy dispersive X-ray spectroscopy (EDAX); FTIR; X-ray diffraction; Atomic Force Microscope (AFM); Scanning Electron Microscope(SEM); Transmission Electron Microscope (TEM); UV-VIS-IR spectroscopy, Thermogravimetric/Diffferential Thermal Analyzer (TG/DTA) **Applications of Nanomaterials:** Applications of nano in biology, nanoprobes for analytical applications, status of nanobiotechnology, future perspectives of nanobiology; nanosensors.	**11**
Keywords	***Nanomaterials, synthesis, characterization, applications, SEM, TEM, IR, UV-visible, TGA, DTA,nanosensors, nanotechnology.***	

Signature of Convener & Members (CBoS):

PART–C

Learning Resources: Text books, Reference Books and Others

Textbooks Recommended–

1. *Keer, H. V. (1993). Principles Of The Solid State. New Age International.*
2. *Rao, C. N. R., Müller, A., & Cheetham, A. K. (Eds.). (2006). The Chemistry Of Nanomaterials: Synthesis, Properties and Applications. John Wiley & Sons.*
3. *Kulkarni, S. K., & Kulkarni, S. K. (2015). Synthesis Of Nanomaterials—II (Chemical Methods). Nanotechnology: Principles And Practices, 77-109.*

Reeference Books Recommended–

1. *Hannay, N. B. (1973). Solid state chemistry. In Electronic Materials (pp. 505-534). Boston, MA: Springer US.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://web.mit.edu/robertsilbey/research/papers/1981-1990/rsilbey_structure_properties_organic_solid_state.pdf
- https://chem.libretexts.org/Courses/Howard_University/General_Chemistry%3A_An_Atoms_First_Approach/Unit_5%3A_States_of_Matter/Chapter_12%3A_Solids/Chapter_12.04%3A_Crystal_Defects
- https://jiwaji.edu/pdf/ecourse/chemistry/Electronic%20Properties%20and%20Band%20%20Theory.pdf
- https://www.researchgate.net/publication/259118068_Chapter_-_INTRODUCTION_TO_NANOMATER

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**
Continuous Internal Assessment (CIA): **30 Marks**
End Semester Exam (ESE): **70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** ~~+20~> Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester - VII**	Session: **2024-2025**	
1	**CourseCode**	**CHSE-10P**		
2	**CourseTitle**	**NANOTECHNOLOGY AND SOLID STATE LAB. COURSE**		
3	**CourseType**	**DSE**		
4	**Pre-requisite(if,any)**	*As per Program*		
5	**CourseLearning.Outcomes(CLO)**	➢ *The consolidation of knowledge about the structure-property relationship of solids through the self-directed synthesis, structure and property determination* ➢ *To apply the knowledge gained on the synthesis, structure and function of solid-state compounds.* ➢ *To acquire knowledge to synthesize nanomaterials and interpret its characteristics.* ➢ *To acquire the knowledge of basic sciences required to understand the fundamentals of nanomaterials*		
6	**CreditValue**	**01Credit (Practical)**	*(Credit = 30Hrs laboratory or Field learning / training)*	
7	**TotalMarks**	**Max.Marks:50**	**MinPassingMarks:20**	

PART-B: Content oftheCourse

TotalNo.ofTraining/performancePeriods (01Hr.perperiod)(30 Period 30hours)

Module	Topics(Coursecontents)	No.of Period
Lab./Field Training/ Experiment Contents of Course	Preparation of several solid-state compounds using different synthesis methods Characterization of the compounds by FTIR and X-ray diffraction Analysis of the crystal structures and the properties of the prepared solids Synthesis and characterization of nanoparticle of Fe_3O_4 by chemical method. Synthesis of graphene oxide from graphene by chemical methods. Synthesis of graphene oxide from graphene by green methods. Synthesis and characterization of Ag nano-particles by green method. Synthesis and characterization of Ag nano-particles by chemical method. Synthesis and characterization of Cu nano-particles by green method. Synthesis and characterization of Cu nano-particles by chemical method. Synthesis and characterization of Ni nano-particles by chemical method. Synthesis and characterization of Ni nano-particles by green method Microwave synthesis of materials. organic compounds. The Nano World. Nanomaterials and Their Synthesis. Characterization Methods for Studying Nanomaterials. Laboratory Safety and Scientific Report Writing.	**30**
Keywords	*X-ray Diffraction;Microwave Synthesis,Nanomaterails, Charecterization, Green Methods.*	

Signature of Convener &Members (CBoS):

PART–C

Learning Resources: Text Books, Reference Books and Others

TextBooks Recommended-

1. *Venkatraman, D., Mukhopadhyay, C., & Das, K. (2018).* ***Introduction to nanoscience and nanomaterials****. McGraw-Hill Education.*
2. *Byrappa, K., & Yoshimura, M. (2010).* ***Functional nanomaterials and devices****. Elsevier.*
3. *Kumar, S. (2018).* ***Green chemistry for sustainable development****. Springer Nature Singapore Pte Ltd.*

Reference Books Recommended-

1. Rao, C. N. R., Müller, A., & Cheetham, A. K. (2007). Nanomaterials chemistry. Wiley-VCH.
2. Chakravarty, A., & Singh, P. (2024). Green synthesis of nanomaterials: Biological and environmental applications. Wiley.
3. Sharon, M. (2018). **Green processes and sustainable chemistry**. Springer Nature Singapore Pte Ltd.
4. Anastas, P. T., & Warner, J. C. (1998). **Green chemistry: Theory and applications**. Oxford University Press.

OnlineResources–

- **https://www.mdpi.com/books/reprint/4856-synthesis-and-characterization-of-nanomaterials**
- **https://swayam.gov.in**
- **https://epathshala.nic.in**
- http://as.wiley.com/WileyCDA/WileyTitle/productCd-EHEP000803.html

Web Resources :-

Not Voodoo
The Safety Net
Comp Chem Website

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 ~~/20~~** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit- **4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: **2024-25**
1	**Course Code**	**CHSE-11T**		
2	**Course Title**	**NATURAL PRODUCTS & MEDICINAL CHEMISTRY**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *To study the occurrence, types, structure, and analysis methods of terpenes and alkaloids and their biosynthesis* ➢ *To grasp key concepts in medicinal chemistry and drug terminology and learn importance of drug structure for activity.* ➢ *To explore specific drug classes and study the medicinal value of natural products*		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Natural Products- Class, Structure and biological importance** Introduction, Natural occurrence, Classification, Uses, general structural features, general methods for structure elucidation including Hoffmann's exhaustive methylation and Emde's method. Terpenes: Isoprene rule Classification of mono- sesqui-, di- and triterpenoids, extraction and biological importance (structure and functions of camphor, citral and α-pinene).	12
II	**Alkaloids and Biosynthesis** Alkaloids: Classification, isolation and biological importance (structure and functions of papaverine, nicotine, coniine). Introduction to biosynthesis: Principles and underlying concepts Building blocks and precursors in biosynthesis (acetate, mevalonate, shikimate, etc.), Enzymatic reactions and their roles in biosynthetic pathways (polyketide synthases, terpene synthases). Biosynthesis of flavonoids and related polyphenols.	11
III	**Introduction to Medicines** Definition of a Medicinal drug, Requirements of an ideal drug, Nomenclature of drugs: Generic name, Brand name, Systematic name Definition of the following medicinal terms: Pharmacon, Pharmacophore, Prodrug, Half-life efficiency, LD50, ED50, Therapeutic Index. (Explanation without including chemistry or structures) Brief idea of the following terms: Receptors, Drug-receptor interaction, Drug Potency, Bioavailability Structure-activity relationships of drug molecules, Quantiative-structure activity relationships (QSAR), binding role of –OH group,-NH_2 group, double bond, and aromatic ring.	11
IV	**Pharmaceutical Compounds** Classification, structure and therapeutic uses of antipyretics - Paracetamol (with	11

	synthesis); Analgesics-Ibuprofen (with synthesis); Antimalarials - Chloroquine (with synthesis); Antitubercular drugs - Isoniazid. An elementary treatment of Antibiotics and detailed study of chloramphenicol, Concept of sedation, hypnotics, and anesthesia Medicinal values of curcumin (haldi), azadirachtin (neem).	
Keywords	***Natural Products, Structure Elucidation, Terpenes & Alkaloids, Medicinal Chemistry, Drug Discovery, Structure-Activity Relationships (SAR), Pharmacokinetics & Pharmacodynamics, Drug Targets, Pharmaceutical Compounds***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Singh, H., & Kapoor, V. K. (1996). Medicinal and Pharmaceutical Chemistry. Vallabh Prakashan.*
2. *Singh, J., Ali, S. M., & Singh, J. (2010). Natural Product Chemistry. Pragati Prakashan.*

Reference Books Recommended –

1. *Finar, I. L., & Finar, A. L. (1998). Organic Chemistry (Vol. 2). Addison-Wesley.*
2. *Foye, W. O., Lemke, T. L., & William, D. A. (1995). Principles of Medicinal Chemistry. B.I. Waverly Pvt. Ltd.*
3. *Hertweck, C. (2012). Natural Product Biosynthesis. Springer-Verlag Berlin Heidelberg.*
4. *Patrick, G. (2017). Introduction to Medicinal Chemistry. Oxford University Press.*

Online Resources–

- https://m.youtube.com/watch?v=H2b-2msgjEE)
- (https://www.genome.jp/kegg/)
- (https://pubchem.ncbi.nlm.nih.gov/)
- (https://onlinecourses.nptel.ac.in/noc23_cy58/preview)
- (https://archive.nptel.ac.in/courses/104/106/104106106/)
- (https://nptel.ac.in/courses/104105076)

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks
Continuous Internal Assessment (CIA): 30 Marks
End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** / **20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**CHSE-11P**		
2	**Course Title**	**NATURAL PRODUCTS AAND MEDICINAL CHEMISTRY LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***Demonstrate competence in determining the physicochemical properties of drugs relevant to their biological activity.*** ➢ ***Gain practical experience in the synthesis and characterization of common drugs.*** ➢ ***Develop skills in isolating natural products from plant sources and analyzing their purity.*** ➢ ***Evaluate the antimicrobial potential of natural product extracts or synthetic drugs.*** ➢ ***Integrate theoretical concepts of medicinal chemistry with laboratory techniques.***		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	Determination the solubility of drug at room temperature Determination of pK_a of drug value by Half Neutralization/ Henderson Hassel Balch equation Determination of Partition of co- efficient of a drug in octanol(other solvent) and water Synthesis and Characterization of some common drugs: paracetamol, Aspirin (Acetylsalicylic Acid) etc Isolation & Characterization: Isolation of the product, determine the yield, and perform characterization using melting point and infrared (IR) spectroscopy. **Antimicrobial Activity Assay:** This practical could involve testing the inhibitory effect of a common antiseptic or a natural product extract on bacterial growth using an agar diffusion assay. Isolation of natural products: Caffeine from Tea Leaves, Pigments from Flowers, Essential Oils from Leaves, Curcumin from Turmeric	**30**
Keywords	***Physicochemical properties, Drug synthesis, Drug characterization, Natural product isolation, Spectroscopy, Antimicrobial activity, Solubility, Partition coefficient***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Iyengar, M. S. (2009). Pharmacognosy and Phytomedicinal Plants. CRC Press. Organic Chemistry Laboratory Techniques. Pearson Education Limited.*
2. Gupta, Y. K. (2009). **Practical pharmaceutical chemistry - I.** CBS Publishers & Distributors Pvt. Ltd.

Reference Books Recommended –

1. *Stovall, J. C. (2010). Experimental Organic Chemistry: A Miniscale and Microscale Approach. Cengage Learning.*
2. *Martin, A. (2010). Physical Pharmacy (6th ed.). Lippincott Williams & Wilkins.*
3. *Parrott, E. L. (2009). Experimental Pharmaceutics. CRC Press.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.ncbi.nlm.nih.gov/books/NBK548557/
- https://www.sigmaaldrich.com/technical-documents/protocols/chemistry/drug-discovery-and-development/partition-coefficient-(log-p)-determination.html
- https://www.sciencedirect.com/science/article/pii/S0022354915332010
- https://www.chm.bris.ac.uk/webprojects2002/sleath/Synthesis.htm
- https://www.michiganstateuniversityonline.com/resources/chemistry/synthesis-and-characterization-of-aspirin/
- https://chem.libretexts.org/Courses/University_of_California_Davis/UCD_Chem_124A%3A_Kauzlarich/Text/04._Infrared_Spectroscopy/4.2%3A_IR_Spectroscopy_Analysis
- https://journals.asm.org/doi/pdf/10.1128/9781555818722.ch15
- https://www.michiganstateuniversityonline.com/resources/chemistry/isolation-of-caffeine-from-tea/
- https://www.life.illinois.edu/mcb/150/SP04/LabManual/natural_products.pdf

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **S. Performed the Task based on lab. work - 20 Marks** **T. Spotting based on tools & technology (written) – 10 Marks** **U. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Honors/Honors with Research)*			**Semester–VIII**	Session:**2024-2025**
1	**Course Code**	**CHSE-12T**		
2	**Course Title**	**INSTRUMENTAL METHODS OF ANALYSIS**		
3	**Course Type**	**DSE**		
4	**Pre-requisite (if, any)**	***As per Program***		
5	**CourseLearning. Outcomes(CLO)**	➢ ***Understand the importance of sampling and sample treatment.*** ➢ ***Select appropriate sampling technique based on sample and target analyte.*** ➢ ***Explain principle and instrumentation involved in AAS.*** ➢ ***Deduce the necessity to remove interferences in AAS and methods involved.*** ➢ ***Select proper technique among the available techniques.*** ➢ ***Formulate experiments based on optical and electroanalytical techniques.***		
6	**Credit Value**	**03Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max.Marks:100**		**MinPassingMarks:40**

PART-B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Module /Unit	Topics(Coursecontents)	No.of Period
I	**Sampling and sample treatment:** Criteria for representative sample. Techniques of sampling of gases (ambient air and exhaust gases), liquids (water and milk samples), solids (soil and coal samples) and particulates. Hazards in sampling. Safety aspects in handling hazardous chemicals. Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion, fusion processes and dissolution of organic samples. Detection and quantification: Concepts and difference between sensitivity, limit of detection and limit of quantification, role of noise in determination of detection limit of analytical techniques. Methods of quantification: Absolute method, comparison method, calibration curve method, standard addition method and internal standard method.	11
II	**Polarography and amperometry** Polarography: Principle of DC polarography. Instrumentation in polarography. Advantages and limitations of DME. Types of currents- residual current, migration current, diffusion current, limiting current, adsorption current, kinetic current and catalytic current. Ilkovic equation-diffusion current constant and capillary characteristics. Derivation of equation of polarographic wave and half wave potential. Experimental determination of half wave potential. Reversible, quasi reversible and irreversible electrode reactions. Polarographic maxima and maximum suppressor. Oxygen interference and deaeration. Introduction to pulse, a.c. and oscillographic techniques and their advantages. Applications of polarography in determination of dissolved oxygen, metal ion quantification and speciation, simultaneous determination of metal ions, analysis of organic compounds. Limitations of polarography.	12

	Amperometric titrations: Principle, types and applications in analytical chemistry.	
III	**Atomic absorption spectroscopy**: Principle. Atomic energy levels. Grotrian diagrams. Population of energy levels. Instrumentation. Sources: Hollow cathode lamp and electrodeless discharge lamp, factors affecting spectral width. Atomizers: Flame atomizers, graphite rod and graphite furnace. Cold vapors and hydride generation techniques. Factors affecting atomization efficiency, flame profile. Monochromators and detectors. Beam modulation. Detection limit and sensitivity. Interferences and their removal. Comparison of AAS and flame emission spectrometry. Applications of AAS.	**11**
IV	**Miscellaneous techniques** **Fluorometry and phosphorimetry:** Principles of fluorescence and phosphorescence. Jablonski diagram. Concentration dependence of fluorescence intensity. Fluorescence quenching. Instrumentation. Applications. **Nephelometry and turbidimetry:** Principle, instrumentation, and applications. **Photoacoustic spectroscopy:** Theory. Instrumentation. Advantages over absorption spectroscopy. Chemical and surface applications of PAS	**11**
Keywords	***Sample, sample treatment, Polarography, Amperometry, Atomic absorption spectroscopy, Instrumentation, fluorometry, Phoshorimetry, Nephelometry, turbidimetry,Photoacoustic spectroscopy.***	

SignatureofConvener & Members (CBoS):

PART–C

LearningResources:Textbooks,ReferenceBooksandOthers

Textbooks Recommended–

1. *Bhatt, B. I., & Vora, S. M. (2008). Stoichiometry (2nd ed.). Tata McGraw-Hill Publishing Company Ltd.*
2. *Chatwal, G., & Anand, S. (2013). Instrumental methods of analysis. Himalaya Publishing House.*
3. *Khopkar, S. M. (2003). Basic concepts in analytical chemistry. New Age International Publishers*

Reference Books Recommended–

1. *Anderson, R. (1986). Sample pre-treatment and separation. John Wiley and Sons.*
2. *Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (1986). Vogel's textbook of quantitative inorganic analysis. ELBS.*
3. *Braun, R. D. (2004). Instrumental methods of chemical analysis. Tata McGraw-Hill Education.*
4. *Christian, G. D. (2013). Analytical chemistry. Wiley India.*
5. *Day, R. A., & Underwood, A. L. (1986). Quantitative analysis. Prentice-Hall of India.*
6. *Ewing, G. W. (1975). Instrumental methods of chemical analysis. G. W. Ewing.*
7. *Meites, L., & Thomas, H. C. (1977). Advanced analytical chemistry. McGraw-Hill.*
8. *Meites, L., & Thomas, H. C. (1990). Advance analytical chemistry: Meites and Thomas. McGraw-Hill.*
9. *Skoog, D. A., & West, D. M. (1976). Fundamentals of analytical chemistry.*
10. *Shyder, L. R., & Harvath, C. H. (1983). An introduction to separation science. Wiley Interscience.*
11. *Sane, S. S., & Joshi, M. V. (2011). Electroanalytical chemistry. Quest Publications.*
12. *Kolthoff, I. M., & Lingane, J. J. (1952). Polarography.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://people.umass.edu/~mcclemen/581Sampling.html
- https://nptel.ac.in/courses/104105084
- https://egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8.pdf

- https://mvpsvktcollege.ac.in/wp-content/uploads/2022/11/1-TYAAS.pdf
- https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/downloads/FLUORIMETRY.pdf
- https://courseware.cutm.ac.in/wp-content/uploads/2020/06/nephelometry-and-turbidimetry.pdf
- https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Photoacoustic_Spectroscopy

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 ~~40~~ 20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Honors/Honors with Research)*			Semester-VIII	Session:2024-2025
1	Course Code	CHSE-12P		
2	Course Title	INSTRUMENTAL METHOD OF ANALYSIS LAB. COURSE-I		
3	Course Type	DSE		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning Outcomes (CLO)	➢ *Understanding fundamental principles of polarography and amperometry.* ➢ *Understand the working principle of UV-visible and Atomic absorption spectroscopy.* ➢ *Handling and working with Fluorometer, understanding fluorescence quenching.* ➢ *Handling of flame photometer instrument.* ➢ *To determine concentration of ions in different samples by Nephelo-Turbidometry.*		
6	Credit Value	01Credit	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max.Marks:50		MinPassingMarks:20

PART-B: Content oftheCourse		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course.	**Polarography and Amperometry:** • Determination of half wave potential E1/2 and unknown concentration of Cu or Pb or Zn ion. • Amperometric titration of $Pb(NO_3)_2$ with $K_2Cr_2O_7$.	30
	Absorption spectroscopy: Experiment 7: Atomic Absorption Spectroscopy – Determination of the Amount of Copper and Zinc in a Brass Alloy Experiment 7: Atomic Absorption Spectroscopy – Determination of the Amount of Copper and Zinc in a Brass Alloy • Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds. • To determine lambda max (λ_{max}) of phenol and effects of solvents on absorption spectra of phenol. • Assay of paracetamol by UV- Spectrophotometry • To determine the amount of Ca in a sample using the standard calibration curve- Atomic Absorption Spectroscopy (AAS).	
	Fluorimetry and Flame Photometry: • To perform the assay of Riboflavin tablets by fluorimetry • Estimation of quinine sulfate by fluorimetry • Study of quenching of fluorescence • To study the effect of concentration in fluorescence intensity of quinine	

	sulphate solution. • To determination concentration of sodium in given unknown sample by Flame photometry • To determination concentration of potassium in given unknown sample by Flame photometry
	Nephelometry and turbidimetry: • To determine phosphate ion concentration in water sample by Nephelo-Turbidometry. • To determine sulphate and/or chloride ion concentration in water sample by Nephelo-Turbidometry.
Keywords	***Polarography, Amperometry, Absorption Spectroscopy, Fluorimetry, Flame Photometry, Nephelometry, Turbidimetry, Fluorescence, Lambda Max, Absorbance, concentration.***

Signature of Convener & Members (CBoS) :

PART–C,

Learning Resources: TextBooks, Reference Books and Others

Textbooks Recommended–

1. *Sharma, B. K. (1981). Instrumental methods of chemical analysis. Krishna Prakashan Media.*
2. *Badwaik, H. R., Thote L.K.; Giri, T.K. (2022). Practical Handbook: Instrumental methods of analysis. Vallabh Prakashan. Delhi, India.*
3. *Sethi, P. D. (1985). Quantitative analysis of drugs in pharmaceutical formulations. Unique Publishers.*

Reference Books Recommended–

1. *Vogel, A. I., & Jeffery, G. H. (1989). Vogel's textbook of quantitative chemical analysis. (No Title).*
2. *Stenlake, J. B. (1976). Practical pharmaceutical chemistry. Athlone Press.*

OnlineResources– e-Resources/e-booksande-learningportals

- https://egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8.pdf
- https://mlrip.ac.in/wp-content/uploads/2022/03/INSTRUMENTAL-METHODS-OF-ANALYSIS-LAB-MANUAL.pdf
- https://www.studyandscore.com/studymaterial-detail/flame-photometer-principle-components-working-procedure-applications-advantages-and-disadvantages
- https://www.youtube.com/watch?v=DFQd0Ncj76w
- https://www.studocu.com/en-ie/document/national-university-of-ireland-maynooth/analytical-chemistry/ch202-experiment-7-atomic-absorption-spectroscopy-determination-of-the-amount-of-copper-and-zinc/7019987
- https://www.scribd.com/document/434710621/EXP-4-AAS

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**
Continuous Internal Assessment (CIA): **30 Marks**
End Semester Exam (ESE): **70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** ~~**40**~~ **20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester - I**	Session: 2024-2025
1	**Course Code**	**CHGE-01T**		
2	**Course Title**	**FUNDAMENTAL CHEMISTRY-I**		
3	**Course Type**	**GE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***To know the contributions of ancient Indian scientists, study atomic structure, and periodic properties.*** ➢ ***To explore the concept of chemical bonding, including ionic and covalent bonding, hybridization, molecular orbital theory and intermolecular interactions.*** ➢ ***To learn about reaction mechanisms of inorganic reactions and their stoichiometry.*** ➢ ***To understand different acid-base theories and solvent system.***		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**A. Chemistry in Ancient India:** (a) Chemical techniques in ancient India: General Introduction (b) Contribution of ancient Indian scientists in chemistry, e.g., metallurgy, dyes, pigments, cosmetics, Ayurveda, Charak Sanhita. **Ancient Indian Chemist-** Their Contribution and Books- Rishi Kanad, Aacharya Nagarjuna, Vagbhatta, Govindacharya, Yashodhar, Ramchandra, Somadava, Gopalbhatta etc. Indian Chemist of 19th century- Aacharya Prafulla Chandra Ray- His Contribution and work for Indian Chemistry. **B. Atomic Structure and Periodic Properties:** (i) Review of Bohr's theory and its limitations. Dual nature of particles and waves, de Broglie's equation, Heisenberg's Uncertainty principle and its significance. (ii) Quantum numbers and their significance. Rules for filling electrons in various orbitals, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals. Anomalous electronic configurations. (iii)Effective nuclear charge (ENC), shielding or screening effect, Slater rules, Atomic and Ionic radii. Ionization energy and factors affecting ionization energy. Electron affinity, Electronegativity—Pauling's/Mulliken's electronegativity scales. Relation of electronegativity with hybridization.	11
II	**Chemical Bonding – I A) Ionic Bonding:** General characteristics of ionic bonding. **Ionic Bonding & Energy:** Lattice and solvation energies and their importance in the context of stability and solubility of ionic compounds. **Born-Haber Cycle and its Applications:** Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules. **B) Covalent Bonding:** Lewis structures, Valence Bond theory, Hybridization (concept and types with suitable examples), dipole moment and percentage ionic character. Valence shell electron pair repulsion theory (VSEPR) and structure of NH_3, H_2O, SF_4, ClF_3, PCl_5, SF_6, XeF_2, XeF_6, XeO_3, $XeOF_4$, XeF_4.	12

	Chemical Bonding - II **A) MO theory:** LCAO method-criteria of orbital, overlap, types of molecular orbitals-σ-, π- and, δ-MOs; formation of σ- and π-MOs and their, schematic illustration; qualitative MO energy, level diagram of homo- (N_2 & O_2(including peroxide, superoxide)) and hetero-diatomic molecules (NO, CO), magnetic properties, bond order and stability of molecules and ions. **B)** Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment).	
III	**A. Chemical properties of s-block metals** Reaction with water, air, and nitrogen, Anomalous behavior of Li and Be, Compounds of s-block metals: Oxides, hydroxides, peroxides, and superoxides (preparation and properties) Complexes of s-block metals, Complexes with crown ethers **B. Chemistry of p-Block Elements** **Boron group:** Hydrides (classification of boranes), Diborane (preparation, properties, and structure elucidation), Borazine (preparation and structure) **Carbon group:** Carbides (salt-like carbides, interstitial carbides, covalent carbides), Silicates (classification, three-dimensional silicates - properties and structures) **Nitrogen group:** Hydrides of Nitrogen (hydrazine, hydroxylamine, hydrazoic acid) Structure of oxides of nitrogen (N_2O, NO, NO_2, N_2O_4, and N_2O_5), Structure of oxyacids of nitrogen (HNO_2, HNO_3, $H_2N_2O_7$,), Nitrides (classification, preparation, properties, and uses) Structure of Oxides and oxoacids of phosphorus: (P_2O_3, P_2O_5) H_3PO_2, H_3PO_3, H_3PO_4, $H_4P_2O_7$ **Halogen:** Hydrides, Oxides and oxyacids of halogens (structure only) – Inter halogen compounds and pseudo halogens	**11**
IV	**Electronic Effects in Organic Compounds** Bond Cleavage: Homolytic and heterolytic cleavages, bond energy, bond length, and bond angle. Electron Displacement Effects: Inductive, inductomeric, electromeric, mesomeric (resonance), hyperconjugation, and steric effects. Tautomerism (keto-enol, amido-imidol, and nitro-acinitro forms). Reaction Intermediates: Formation and stability of carbocations, carbanions, free radicals, carbenes, nitrene and benzyne. **B. Stereochemistry of Organic Compounds** **i) Optical Isomerism** Elements of symmetry, chirality, enantiomers, and optical activity, Chiral and achiral molecules with two stereogenic centers (Tartaric acid as an example),Erythreo & Threo, Diastereomers and meso compounds, Inversion, retention, and racemization, Relative configuration (D/L), and absolute configuration (R/S nomenclature: sequence rules). **ii) Geometrical Isomerism** Geometric isomerism (cis-trans isomerism) in alkenes with examples (maleic acid, fumaric acid, and 2-butene), E/Z system of nomenclature.	**11**
Keywords	***Ancient Indian Chemistry, Atomic Structure, Periodic Properties, Chemical Bonding, s- &p-block elements, Electronic effects, Stereochemistry***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

Text Books

1. Puri, B. R., Sharma, L. R., & Kalia, K. C. (2018). *Principles of Inorganic Chemistry*. Nagin Chand and Co., New Delhi.
2. Satyaprakash, G., Tuli, S. K., Basu, S. K., & Madan, R. D. (2017). *Advanced Inorganic Chemistry* (Vol. 1, 5th Ed.). S. Chand & Company.
3. Lee, J. D. (2010). *Concise Inorganic Chemistry* (5th Ed.). Blackwell Science.
4. Housecroft, C. E., & Sharpe, A. G. (2012). *Inorganic Chemistry* (4th Ed.). Pearson Education Limited.

Reference Books

1. Cotton, F. A., Wilkinson, G., & Gaus, P. L. (2002). *Basic Inorganic Chemistry* (3rd Ed.). John Wiley & Sons.
2. Douglas, B. E., Mcdaniel, D. T., & Alexander, J. J. (1994). *Concepts and Models Of Inorganic Chemistry* (3rd Ed.). John Wiley & Sons.
3. Huheey, J. E., Keiter, E. A., & Keiter, R. L. (1993). *Inorganic Chemistry* (4th Ed.). Harpercollins College Publishers.
4. Shriver, D. F., Atkins, P. W., & Langford, C. H. (2010). *Inorganic Chemistry* (5th Ed.). W. H. Freeman And Company.
5. Moeller, T. (1990). *Inorganic Chemistry: A Modern Introduction*. Wiley.

Online Resources–

- https://bit.ly/3AyV3mZ
- https://nptel.ac.in/courses/104/104/104104101/
- https://nptel.ac.in/courses/104/103/104103019/
- https://nptel.ac.in/courses/104/101/104101090/
- https://nptel.ac.in/courses/104/105/104105103/

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** / **20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester - I**	Session: **2024-2025**
1	**Course Code**	**CHGE-01P**		
2	**Course Title**	**Chemistry Lab. Course-I**		
3	**Course Type**	**GE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *Analyze mixtures for cations (NH_4^+, Pb^{2+}, etc.) & anions (CO_3^{2-}, S^{2-}, etc.) using H_2S or other methods.* ➢ *Perform titrimetric analysis (standardization, unknown conc. determination).* ➢ *Estimate the concentration of acetic acid in vinegar (using NaOH), alkali content in antacids (using HCl), and free alkali in soaps/detergents.* ➢ *Utilize complexometric titrations for calcium (Ca^{2+}), water hardness, Fe^{2+}/Fe^{3+}, and Cu^{2+}.*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**QUALITATIVE INORGANIC MIXTURE ANALYSIS:** Inorganic mixture analysis containing up to four ionic species (two cations and two anions) using H_2S (hydrogen sulfide) or other appropriate methods (Excluded are interfering and insoluble salts) Cations and anions that may be encountered include: **Cations:** NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{2+}/Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Na^+ **Anions:** CO_3^{2-}, S^{2-}, SO_4^{2-}, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_2^-, SO_3^{2-} (Spot tests may be used wherever feasible.) **TITRIMETRIC ANALYSIS** Standardize sodium hydroxide solution using a standard oxalic acid solution. Determine the concentration of hydrochloric acid (HCl) solution using standardized sodium hydroxide solution as an intermediate.	**30**
Keywords	*Qualitative Analysis (H_2S method, Cations (NH_4^+, Pb^{2+}, etc.), Anions (CO_3^{2-}, S^{2-}, etc.), Titrimetric Analysis, Standardization (NaOH solution), Concentration Determination (HCl solution)*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Gurtu, J. N., & Kapoor, R. (1987). *Experimental Chemistry*. S. Chand & Co.
2. Bajpai, D. N., Pandey, O. P., & Giri, S. (2013). *Practical Chemistry*. S. Chand & Co.
3. Ahluwalia, V. K., Dhingra, S., & Dhingram, S. (2005). *College Practical Chemistry*. Universities Press.
4. Kamboj, P. C. (2014). *Advanced University Practical Chemistry* (Part I). Vishal Publishing Co.
5. Fultariya, C., & Harsora, J. (2017). *Volumetric Analysis: Concepts and Experiments*.

Reference Books Recommended:

1. Mcpherson, P. A. (2015). *Practical Volumetric Analysis*. Royal Society Of Chemistry.
2. Shobha, R., & Banani, M. (2017). *Essentials of Analytical Chemistry*. Pearson.
3. Venkateswaran, V., Veeraswamy, R., & Kulandaivelu, A. R. (2004). *Basic Principles Of Practical Chemistry* (2nd Ed.). S. Chand Publications.
4. Sundaram, S., & Raghavan, K. (1996). *Practical Chemistry*. S. Viswanathan Co. Pvt.
5. Svehla, G. (2011). *Vogel's Textbook of Inorganic Qualitative Analysis* (7th Ed.). Pearson Education

Online Resources–

- https://bit.ly/3B7tOQV
- https://bit.ly/30V85ze
- https://bit.ly/3B5WOIQ
- https://bit.ly/3C9PXPS
- https://bit.ly/30Ip9rZ
- https://bit.ly/3BPnwqc

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester - II**	Session: **2024-2025**
1	**Course Code**	**CHGE-02T**		
2	**Course Title**	**FUNDAMENTAL CHEMISTRY-II**		
3	**Course Type**	**GE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *To understand different acid-base theories and solvent system .* ➢ *To learn the preparation, bonding, and reactions of C-C σ- & π-bonded compounds* ➢ *To understand the concept and chemistry of aromatic compounds and their reactions* ➢ *To learn the basic concepts of various states of matter &understand the basic concepts of surface chemistry and chemical kinetics*		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Acid, Base and Solvent System** **Theories of acids and bases**: Arrhenius, Bronsted-Lowry, conjugate acids and bases, relative strengths of acids and bases, the Lux-flood, solvent system and Lewis concepts of acids and bases. **HSAB concept**: Classification of Acids and Bases According to HSAB Theory (Hard, Borderline, Soft). Applications of HSAB Theory in Inorganic Reactions - Solubility, Selectivity, Redox Reactions Non-aqueous solvents: .Physical properties of a solvent, types of solvents and their general characteristics, Liquid ammonia as a solvent. Acid-base, precipitation and complex, formation reactions. Solutions of alkali and alkaline earth metals in ammonia-application)	11
II	**CHEMISTRY OF C-C σ–BONDING** Alkanes: Preparation (Wurtz reaction, reduction/hydrogenation of alkenes, Corey-House method). Reactions (mechanisms): halogenation, free radical substitution. Cycloalkanes: Preparation (Dieckmann's ring closure, reduction of aromatic hydrocarbons), Reactions (mechanisms): substitution and ring-opening reactions. Stability of cycloalkanes -Baeyer's strain theory, Sachse and Mohr predictions, Conformational structures of ethane, n-butane and cyclohexane. **CHEMISTRY OF C-C π–BONDING** Alkenes: Preparation methods (dehydration, dehydrohalogenation, dehydrogenation, Hoffmann and Saytzeff rules, cis and trans eliminations). Reactions (mechanisms): electrophilic and free radical addition (hydrogen, halogen, hydrogen halide, hydrogen bromide, water, hydroboration, ozonolysis, dihydroxylation with $KMnO_4$). Dienes: 1,2- and 1,4-additions, Diels-Alder reactions. Alkynes: Preparation (dehydrohalogenation, dehydrogenation), Reactions: Acidity, formation of acetylides, addition of water, hydrogen halides and halogens, oxidation, ozonolysis, hydroboration/oxidation.	12

	Aromatic Hydrocarbons Aromatic hydrocarbons: Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/ carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directive effects of the groups.	
III	**Behaviour of ideal gases:** Kinetic theory of gases – postulates and derivation of the equation, $PV = 1/3\ mnc^2$ and derivation of the gas laws- Maxwell's distribution of molecular velocities-effect of temperature-types of molecular velocities-degrees of freedom-Principle of equipartition of energy. **Behaviour of Real gases:** Deviation from ideal behaviour, derivation of van der Waals, equation of state and critical constants. **Liquid state chemistry:** structure of liquids(Eyring Theory), Properties of liquids, viscosity and surface tension. **Solid state chemistry:** Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, Crystal defects.	**11**
IV	**A. Colloids and surface chemistry:** Classification, Optical, Kinetic and Electrical Properties of colloids, Coagulation, Hardy Schulze law, flocculation value, Protection, Gold number, Emulsion, micelles and types, Gel, Syneresis and thixotropy, Physical adsorption, chemisorption, **B. Chemical kinetics:** Rate of reaction, Factors influencing rate of reaction, rate law, rate constant, Order and molecularity of reactions, rate determining step, Zero, First and Second order reactions, Rate and Rate Law, methods of determining order of reaction, Chain reactions. Temperature dependence of reaction rate, Arrhenius theory, Physical significance of Activation energy, collision theory, demerits of collision theory, non-mathematical concept of transition state theory. **C. Catalysis:** Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristics of catalyst, Enzyme catalyzed reactions, Industrial applications of catalysis.	**11**
Keywords	***Acid & Bases, Alkanes, Cycloalkanes, Alkenes, Dienes, Alkynes, Aromatic Hydrocarbons, Kinetic theory of gases, Real gases, Intermolecular forces, Crystal structure, Chemical kinetics***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Bahl, A., & Bahl, B. S. (2014). *Organic Chemistry* (22nd Ed.). S. Chand & Sons.
2. Ahluwalia, V. K., & Goyal, M. (2001). *A Textbook of Organic Chemistry*. Narosa Publishing House.
3. Jain, M. K., & Sharma, S. C. (2017). *Modern Organic Chemistry*. Vishal Publishing Company.
4. Puri, B. R., Sharma, L. R., & Pathania, M. S. (2013). *Principles of Physical Chemistry* (46th Ed.). Shoban Lal Nagin Chand And Co.
5. Bahl, B. S. A., & Tuli, G. D. (2009). *Essentials of Physical Chemistry* (Multicolour Ed.). S. Chand & Company Pvt Ltd.
6. Puri, B. R., Sharma, L. R., & Kalia, K. C. (2018). *Principles of Inorganic Chemistry*. Nagin Chand and Co., New Delhi.

Reference Books Recommended:

1. Paula, B. Y. (2014). *Organic Chemistry* (7th Ed.). Pearson Education, Inc. (Singapore).
2. Solomons, T. W. G. (2017). *Organic Chemistry* (Global Ed.). John Wiley & Sons.

3. Morrison, R. T., & Boyd, R. N. (2010). *Organic Chemistry* (7th Ed.). Prentice-Hall Of India Limited.
4. Laidler, K. J., & Meiser, J. H. (2006). *Physical Chemistry* (2nd Indian Ed.). CBS Publishers.
5. Atkins, P. W., & De Paula, J. (2006). *Physical Chemistry* (8th Ed.). Oxford University Press.
6. Dogra, S., & Dogra, S. (2006). *Physical Chemistry through Problems* (2nd Ed.). New Age International.
7. Sangaranarayanan, M. V., & Mahadevan, V. (2011). *Textbook of Physical Chemistry*. University Press.

Online Resources–

- **Online Resources–**
- **https://bit.ly/3Gb99iy**
- **https://www.organic-chemistry.org/**
- **https://bit.ly/3GduvMi**
- **https://bit.ly/30TXm8d**
- **Web Resources**
- **https://application.wiley-vch.de/books/sample/3527316728_c01.pdf**
- **https://www.ncbi.nlm.nih.gov/books/NBK547716/**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 ~~/20~~** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree)*			**Semester - II**	Session: **2024-2025**
1	**Course Code**	**CHGE-02P**		
2	**Course Title**	**Chemistry Lab. Course-II**		
3	**Course Type**	**GE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *Demonstrating and using common glassware for accurate measurements* ➢ *Studying the functional group analysis organic compounds* ➢ *Determining melting points to assess compound purity and employing distillation and sublimation techniques to establish boiling points* ➢ *Equipping with essential skills in measuring liquid surface tension and solution viscosity*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**Basic Laboratory Techniques** Demonstration of Laboratory Glassware and Equipment, Calibration of Thermometer : 80-82°C (Naphthalene), 113.5°-114°C (Acetanilide), 132.5°C - 133°C (Urea), 100°C (Distilled Water) **Functional group Analysis of Organic Compounds,** Detection of elements (N, S, and halogens) and functional groups **Physical chemistry** Surface tension measurements: Determine the surface tension by (i) drop number (ii) drop weight method. Surface tension composition curve for a binary liquid mixture. Viscosity measurement using Ostwald's viscometer, Determination of viscosity of aqueous solutions of (i) sugar (ii) ethanol at room temperature. Study of the variation of viscosity of sucrose solution with the concentration of solute. Viscosity Composition curve for a binary liquid mixture	**30**
Keywords	***Basic laboratory techniques, Equipments, Calibration, Melting points, Qualitative analysis, Physical chemistry, Surface tension, Viscosity***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Ahluwalia, V. K., Dhingra, S., & Gulati, A. (N.D.). *College Practical Chemistry*. University Press.
2. Khosla, B. D., Garg, V. C., & Gulati, A. (2011). *Senior Practical Physical Chemistry*. R. Chand & Co.

Reference Books Recommended:

1. Garland, C. W., Nibler, J. W., & Shoemaker, D. P. (2003). *Experiments in Physical Chemistry* (8th Ed.). Mcgraw-Hill.
2. Mendham, J. (2009). *Vogel's Quantitative Chemical Analysis* (6th Ed.). Pearson Education.
3. Mann, F. G., & Saunders, B. C. (2009). *Practical Organic Chemistry*. Pearson Education.
4. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (2012). *Practical Organic Chemistry* (5th Ed.). Pearson Education.

Online Resources–

- http://heecontent.upsdc.gov.in/Home.aspx
- https://nptel.ac.in/courses/104/106/104106096/
- http://heecontent.upsdc.gov.in/Home.aspx
- https://nptel.ac.in/courses/104/106/104106096/
- https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtml/introl.htm
- https://nptel.ac.in/courses/104/103/104103071/W

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **D. Performed the Task based on lab. work - 20 Marks** **E. Spotting based on tools & technology (written) – 10 Marks** **F. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OFCHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester-I/III/V**	Session: **2024-2025**
1	**Course Code**	**CHVAC**		
2	**Course Title**	**Chemistry in Daily Life**		
3	**Course Type**	**Value Added Course(VAC)**		
4	**Pre-requisite**(if,any)	***As per Program***		
5	**Course Learning Outcomes(CLO)**	➢ ***To introduce the student about dairy product,beverages,food additives, artificial sweeteners, flavors, food colorants, paints, pigments, dyes etc.*** ➢ ***To make aware the students about air pollution, hydrological cycle, composition of soil, fertilizers etc.*** ➢ ***To introduce the students about carbohydrate, vitamins,drugs.*** ➢ ***To introduce students about concept of thermodynamics used in day to day life.***		
6	**Credit Value**	**2 Credits**	***Credit = 15 Hours -learning & Observation***	
7	**Total Marks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 30 Periods (30 Hours)

Unit	Topics(Course contents)	No. of Period
I	**Dairy Products:** Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk. **Beverages:** Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, estimation of methyl alcohol in alcoholic beverages. **Food additives, adulterants and contaminants:** Food preservatives like benzoates, propionates, sorbates, disulphites. **Artificial sweeteners:** spartame, saccharin, dulcin, sucralose and sodium cyclamate. **Flavors:** Vanillin, alkyl esters (fruit flavours) and monosodium glutamate. Artificial food colorants: Coal tar dyes and non-permitted colours and metallic salts. Analysis of pesticide residues in food. **Paints & Pigments:** White pigments (white lead, ZnO, lithopone, TiO_2). Blue, red, yellow and green pigments. Paints and distempers: Requirement of a good paint. Emulsion, latex; luminescent paints. Fire retardant paints and enamels, lacquers. Solvents and thinners for paints. **Dyes:** Colour and constitution (electronic concept). Classification of dyes. Methods of applying dyes to the fabrics. A general study of azo dyes, Mordant brown, Congo red and methyl orange.	08
II	**Air Pollution:** Air pollutants, prevention and control, Greenhouse gases and acid rain. Ozone hole and CFC's. Photochemical smog and PAN. Catalytic converters for mobile sources. Bhopal gas tragedy. Hydrologic cycle, sources, criteria and standards of water quality - safe drinking water. Public health significance and measurement of water quality parameters - (Colour, turbidity, total solids, acidity, alkalinity, hardness, sulphate, fluoride, phosphate, nitrite, nitrate, BOD and COD). Water purification for drinking and industrial purposes. Toxic chemicals in the environment. Detergents - pollution aspects, eutrophication. Pesticides and insecticides - pollution aspects. Heavy metal pollution. Solid pollutants - treatment and disposal. Treatment of industrial liquid wastes. Sewage and industrial effluent treatment.	07

	Composition of soil – inorganic and organic components in soil - micro and macronutrients. **Fertilizers:** Classification of fertilizers - Straight Fertilizers, Compound/Complex Fertilizers, Fertilizer Mixtures. Manufacture and general properties of fertilizer products - Urea and DAP.	
III	**Carbohydrates**: Structure, function and Chemistry of some important mono and disaccharides. **Vitamins:** Classification and Nomenclature.Sources, deficiency diseases and structures of Vitamin A_1, Vitamin B_1,VitaminC, Vitamin D, Vitamin E &Vitamin K_1. **Drugs:** Classification and nomenclature. Structure and function of: *Analgesics* –aspirin, paracetamol. *Anthelmentic drug*:mebendazole. *Antiallergic drug:* Chloropheneramine maleate. *Antibiotics:*PenicillinV,Chloromycetin,Streptomycin. *Anti-infalmmatory agent:* Oxypheno-butazone. *Antimalarials:* Primazuine phosphate & Chloroquine. **Oils and fats:** Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like aregemone oil and mineral oils. **Soaps & Detergents:** Structures and methods of use of soaps and detergents.	**08**
IV	**Chemical Thermodynamics**: Concept of fugacity and free energy, Activity and activity coefficient, spontaneity of processes-entropy and free energy changes. Partial molar quantities, colligative properties, Le-Chatelier principle, phase equilibrium. Enzyme catalyzed reactions. **Principles of Reactivity**: Basis kinetic concepts, rates of simple and complex chemical reactions, empirical rate equations.Temperature dependence of rates and activation parameters. Branched chain reactions – explosion limits. Oscillatory reactions. **Chemical energy system** and limitations, principles and applications of primary & secondary batteries and fuel cell. Basics of solar energy, future energy storer. aerospace materials. Problems of plastic waste management.Strategies for the development of environment friendly polymers.	**08**
Keywords	***Air pollution, carbohydrate,vitamins, LeChatteliar's law, Dairy product, artificial sweeteners. fertilizers,Paint,pigment ,dyes.***	

SignatureofConvener&Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Sharma, B. K. (1998). Introduction to Industrial Chemistry. Meerut: Goel Publishing.*
2. *Many, N. S., & Swamy, S. (1998). Foods: Facts and Principles (4th ed.). New Age International.*
3. *Kar, A. (2022). Medicinal Chemistry. NEW AGE International Pvt Ltd*

Reference books Recommended:

1. *Drugs and Pharmaceutical Sciences Series. (Year). Marcel Dekker, Vol. II. New York: INC.*
2. *Atkins, P., & de Paula, J. (2002). Physical Chemistry (7th ed.). Oxford University Press.*
3. *Swaminathan, & Goswamy. (2001). Handbook on Fertilizer Technology (6th ed.). FAI.*
4. *Finar, I. L. (Year). Organic Chemistry (Vol. 1&2).*
5. *Fired, J. R. (Year). Polymer Science and Technology. Prentice Hall.*

Online Resources:

https://onlinecourses.swayam2.ac.in/nos22_sc23/preview
https://www.researchgate.net/publication/343585969_Chemistry_in_Everyday_Life
https://www.youtube.com/watch?v=P3p1C87gc0U
https://www.slideshare.net/sanjaijosephManesh/food-chemistry-51688453

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
End Semester Exam(ESE):35Marks

Continuous InternalAssessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- **05** Total Marks -**15**	Better marks out of thetwo Test / Quiz+obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Two section – A & B** Section **A**: **Q1**. Objective – **05 x1= 05** Mark; **Q2**. Short answer type- **5x2 =10Marks** Section **B**: Descriptive answer type qts.,**1out of 2** from each unit-**4x05=20Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree)*			**Semester - II/IV/V/VI**	Session: **2024-2025**
1	**Course Code**	**CHSEC**		
2	**Course Title**	**GREEN CHEMISTRY**		
3	**Course Type**	**SEC**		
4	**Pre-requisite**(if, any)	***As per Program***		
5	**Course Learning. Outcomes(CLO)**	➢ *Understand needs, goals, and obstacles in green chemistry.* ➢ *Understand and application of twelve principles of chemistry.* ➢ *Design green solvents and green reactions.* ➢ *To interpret and execute case study, survey, and projects on Green Chemistry.*		
6	**Credit Value**	**2 Credits (1C + 1C)**	*Credit = 15 Hours –Theoretical learning and = 30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content of the Course

Total No.of Teaching–learning Periods:
Theory–15 Periods (15 Hrs.) and Lab. or Field learning/Training 30Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Theory Contents	**Introduction to Green Chemistry:** What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry. **Principles of Green Chemistry and Designing a Chemical synthesis:** Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following: • Designing a Green Synthesis using these principles; Prevention of Waste/ by products; maximum incorporation of the materials used in the process into the final products, Atom Economy, addition, substitution, and elimination reactions. • Prevention/ minimization of hazardous/ toxic products reducing toxicity, and risks (hazard × exposure); waste or pollution prevention hierarchy. • Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents. **Future Trends in Green Chemistry:** Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; Green chemistry in sustainable development.	**15**
Lab./Field Training Contents	• Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis). • Microwave assisted reactions in water: Hofmann elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction. • Right fit pigment: synthetic azo pigments to replace toxic organic and inorganic pigments. • An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.	**30**

	Case study/Project Case study/Project on Green chemistry, Role of green chemistry in lab safety, and implications of green chemistry.	
Keywords	***Green chemistry, Green synthesis, Green solvents, Green reactions, principles of Green chemistry, Hofmann elimination, Diels-Alder reaction, oxidation, and reduction.***	

Signature of Convener &Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended–

1. *Ahluwalia, V.K. (2013). Green chemistry: A textbook.Alpha Science International.*
2. *Shukla, S., Gulati, S., & Batra, S.K. (2020). A textbook of green chemistry: benign by design. Shree kala Prakashan.*
3. *Kumar, V. (2013). An introduction to green chemistry. Vishal publishing Co.*
4. *Lancaster, M. (2020). Green chemistry: an introductory text. Royal society of chemistry.*

Reference books Recommended:

1. *Perosa, A., & Zecchini, F. (2007). Methods and reagents for green chemistry: an introduction. John Wiley & Sons.*
2. *Clark, J. H., & Macquarrie, D. J. (Eds.). (2008). Handbook of green chemistry and technology. John Wiley & Sons.*
3. *Ameta, S. C., & Ameta, R. (Eds.). (2023). Green Chemistry: Fundamentals and Applications. CRC press.*
4. *Anastas, P. T. (Ed.). (2013). Handbook of green chemistry (Vol. 1). Wiley-VCH.*

Online Resources- e-Resources / e-books and e-learning portals

- https://www.mygreenlab.org/uploads/2/1/9/4/21945752/gc_-_green_chem_guide-_beyond_benign___my_green_lab.pdf
- https://www.organic-chemistry.org/topics/green-chemistry.shtm
- https://royalsocietypublishing.org/doi/10.1098/rsos.191378
- https://www.gvsu.edu/labsafety/green-chemistry-99.htm

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
End Semester Exam(ESE): 35Marks

Continuous Internal Assessment(CIA): **(By Course Coordinator)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- 05 Total Marks -**15**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on learned skill - 20 Marks** **B. Spotting based on tools (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Coordinator as per skilling**

Name and Signature of Convener & Members of CBoS: