

**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 Iwar 2 K. S. 3 D. 4 K. S. 5 A. 6 S. 7 D. 8 S. 9 B. 10 S.

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**Chairman**  
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 Vishwavidyalaya, Raigarh (C.G.)

# FOUR YEAR UNDERGRADUATE PROGRAM (NEP-2020)

## Program: Bachelor in Science

### DISCIPLINE-CHEMISTRY

Session-2024-28

#### 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

Chairman

of Studies .....  
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Indira

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

<b>PART- A: Introduction</b>			
Program: Bachelor in Science <i>(Certificate / Diploma / Degree/Honors)</i>		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)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> <li>➤ To know the contributions of ancient Indian scientists, study atomic structure, and periodic properties.</li> <li>➤ To explore the concept of chemical bonding, including ionic and covalent bonding, hybridization, molecular orbital theory and intermolecular interactions.</li> <li>➤ To learn about reaction mechanisms of inorganic reactions and their stoichiometry.</li> <li>➤ To understand basics principles of organic chemistry.</li> </ul>	
6	Credit Value	3 Credits	Credit = 15 Hours - learning & Observation
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
<b>PART -B: Content of the Course</b>			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)	No. of Period	
I	<b>A. Chemistry in Ancient India:</b> (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. <b>Ancient Indian Chemist-</b> Their Contribution and Books- Rishi Kanad, Acharya Nagarjuna, Vagbhatta, Govindacharya, Yashodhar, Ramchandra, Somadava, Gopalbhatta etc. Indian Chemist of 19th century- Acharya Prafulla Chandra Ray- His Contribution and work for Indian Chemistry. <b>B. Atomic Structure and Periodic Properties:</b> (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	<b>Chemical Bonding – I A) Ionic Bonding:</b> General characteristics of ionic bonding. <b>Ionic Bonding &amp; Energy:</b> Lattice and solvation energies and their importance in the context of stability and solubility of ionic compounds. <b>Born-Haber Cycle and its Applications:</b> Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules. <b>B) Covalent Bonding:</b> 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 <sub>3</sub> , H <sub>2</sub> O, SF <sub>4</sub> , ClF <sub>3</sub> , PCl <sub>5</sub> , SF <sub>6</sub> , XeF <sub>2</sub> , XeF <sub>6</sub> , XeO <sub>3</sub> , XeOF <sub>4</sub> , XeF <sub>4</sub> .	12	

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	<p><b>Chemical Bonding - II</b></p> <p>A) <b>MO theory:</b> LCAO method-criteria of orbital overlapping, types of molecular orbitals-<math>\sigma</math>-, <math>\pi</math>- and, <math>\delta</math>-MOs; formation of <math>\sigma</math>- and <math>\pi</math>-MOs and their, schematic illustration; qualitative MO energy level diagram of homo- (<math>N_2</math> &amp; <math>O_2</math>(including peroxide, superoxide) ) and hetero-diatomic molecules (<math>NO</math>, <math>CO</math>), magnetic properties, bond order and stability of molecules and ions.</p> <p>B) <b>Weak Chemical Forces:</b> 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).</p>	
III	<p><b>A. Chemical properties of s-block metals</b> 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</p> <p><b>B. Chemistry of p-Block Elements</b> <b>Boron group:</b> Hydrides (classification of boranes), Diborane (preparation, properties, and structure elucidation), Borazine (preparation and structure) <b>Carbon group:</b> Carbides (salt-like carbides, interstitial carbides, covalent carbides), Silicates (classification, three-dimensional silicates - properties and structures) <b>Nitrogen group:</b> Hydrides of Nitrogen (hydrazine, hydroxylamine, hydrazoic acid) Structure of oxides of nitrogen (<math>N_2O</math>, <math>NO</math>, <math>NO_2</math>, <math>N_2O_4</math>, and <math>N_2O_5</math>), Structure of oxyacids of nitrogen (<math>HNO_2</math>, <math>HNO_3</math>, <math>H_2N_2O_7</math>), Nitrides (classification, preparation, properties, and uses) Structure of Oxides and oxoacids of phosphorus: (<math>P_2O_3</math>, <math>P_2O_5</math>) <math>H_3PO_2</math>, <math>H_3PO_3</math>, <math>H_3PO_4</math>, <math>H_4P_2O_7</math> <b>Halogen:</b> Hydrides, Oxides and oxyacids of halogens (structure only) – Inter halogen compounds and pseudo halogens</p>	11
IV	<p><b>Electronic Effects in Organic Compounds</b> 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.</p> <p><b>B. Stereochemistry of Organic Compounds</b> i) <b>Optical Isomerism</b> Elements of symmetry, chirality, enantiomers, and optical activity, Chiral and achiral molecules with two stereogenic centers (Tartaric acid as an example), Erythro &amp; Threo, Diastereomers and meso compounds, Inversion, retention, and racemization, Relative configuration (D/L), and absolute configuration (R/S nomenclature: sequence rules). ii) <b>Geometrical Isomerism</b> Geometric isomerism (cis-trans isomerism) in alkenes with examples (maleic acid, fumaric acid, and 2-butene), E/Z system of nomenclature.</p>	11
Keywords	Ancient Indian Chemistry, Atomic Structure, Periodic Properties, Chemical Bonding, s- & p-block elements, Electronic effects, Stereochemistry	

Signature of Convener & Members (CBoS) :

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## 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:

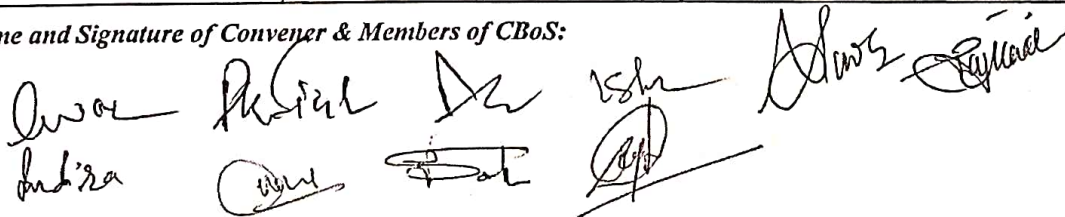
Maximum Marks: 100 Marks

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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10 Total Marks - 30	
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	

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**DEPARTMENT OF CHEMISTRY**  
**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
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)	<ul style="list-style-type: none"> <li>➤ Analyze mixtures for cations (<math>\text{NH}_4^+</math>, <math>\text{Pb}^{2+}</math>, etc.) &amp; anions (<math>\text{CO}_3^{2-}</math>, <math>\text{S}^{2-}</math>, etc.) using <math>\text{H}_2\text{S}</math> or other methods.</li> <li>➤ Perform titrimetric analysis (standardization, unknown conc. determination).</li> <li>➤ Estimate the concentration of acetic acid in vinegar (using <math>\text{NaOH}</math>), alkali content in antacids (using <math>\text{HCl}</math>), and free alkali in soaps/detergents.</li> <li>➤ Utilize complexometric titrations for calcium (<math>\text{Ca}^{2+}</math>), water hardness, <math>\text{Fe}^{2+}/\text{Fe}^{3+}</math>, and <math>\text{Cu}^{2+}</math>.</li> </ul>	
6	Credit Value	1 Credits	Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
<b>PART -B: Content of the Course</b>			
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	<b>QUALITATIVE INORGANIC MIXTURE ANALYSIS:</b> Inorganic mixture analysis containing up to four ionic species (two cations and two anions) using $\text{H}_2\text{S}$ (hydrogen sulfide) or other appropriate methods (Excluded are interfering and insoluble salts) Cations and anions that may be encountered include: Cations: $\text{NH}_4^+$ , $\text{Pb}^{2+}$ , $\text{Bi}^{3+}$ , $\text{Cu}^{2+}$ , $\text{Cd}^{2+}$ , $\text{Fe}^{2+}/\text{Fe}^{3+}$ , $\text{Al}^{3+}$ , $\text{Co}^{2+}$ , $\text{Ni}^{2+}$ , $\text{Mn}^{2+}$ , $\text{Zn}^{2+}$ , $\text{Ba}^{2+}$ , $\text{Sr}^{2+}$ , $\text{Ca}^{2+}$ , $\text{Na}^+$ Anions: $\text{CO}_3^{2-}$ , $\text{S}^{2-}$ , $\text{SO}_4^{2-}$ , $\text{NO}_3^-$ , $\text{CH}_3\text{COO}^-$ , $\text{Cl}^-$ , $\text{Br}^-$ , $\text{I}^-$ , $\text{NO}_2^-$ , $\text{SO}_3^{2-}$ (Spot tests may be used wherever feasible.) <b>TITRIMETRIC ANALYSIS</b> Standardize sodium hydroxide solution using a standard oxalic acid solution. Determine the concentration of hydrochloric acid ( $\text{HCl}$ ) solution using standardized sodium hydroxide solution as an intermediate.	30	
Keywords	Qualitative Analysis ( $\text{H}_2\text{S}$ method, Cations ( $\text{NH}_4^+$ , $\text{Pb}^{2+}$ , etc.), Anions ( $\text{CO}_3^{2-}$ , $\text{S}^{2-}$ , etc.), Titrimetric Analysis, Standardization ( $\text{NaOH}$ solution), Concentration Determination ( $\text{HCl}$ 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., & Dhingra, 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. Mepherson, P. A. (2015). *Practical Volumetric Analysis*. Royal Society Of Chemistry.
2. Shobha, R., & Banani, M. (2017). *Essentials of Analytical Chemistry*. Pearson.
3. Venkateswaran, V., Vecraswamy, 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/3B7t0QV>
- <https://bit.ly/30V85ze>
- <https://bit.ly/3B5W0IQ>
- <https://bit.ly/3C9PXPS>
- <https://bit.ly/30Ip9rZ>
- <https://bit.ly/3BPnwgc>

#### 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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance - 05	
	Total Marks - 15	

End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment		Managed by Course teacher as per lab. status
	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	

Name and Signature of Confener & Members of CBoS:

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Anwar  
Rohit  
Ankur  
K. S. Sharma  
Anurag  
S. K. Singh

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

<b>PART- A: Introduction</b>			
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)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> <li>➤ To understand different acid-base theories and solvent system .</li> <li>➤ To learn the preparation, bonding, and reactions of C-C <math>\sigma</math>- &amp; <math>\pi</math>-bonded compounds</li> <li>➤ To understand the concept and chemistry of aromatic compounds and their reactions</li> <li>➤ To learn the basic concepts of various states of matter &amp; understand the basic concepts of surface chemistry and chemical kinetics</li> </ul>	
6	Credit Value	3 Credits	Credit = 15 Hours - learning & Observation
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
<b>PART -B: Content of the Course</b>			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)	No. of Period	
<b>I</b>	<b>Acid, Base and Solvent System</b> 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)	<b>11</b>	
<b>II</b>	<b>CHEMISTRY OF C-C <math>\sigma</math>-BONDING</b> 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. <b>CHEMISTRY OF C-C <math>\pi</math>-BONDING</b> 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 $\text{KMnO}_4$ ). 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,	<b>12</b>	

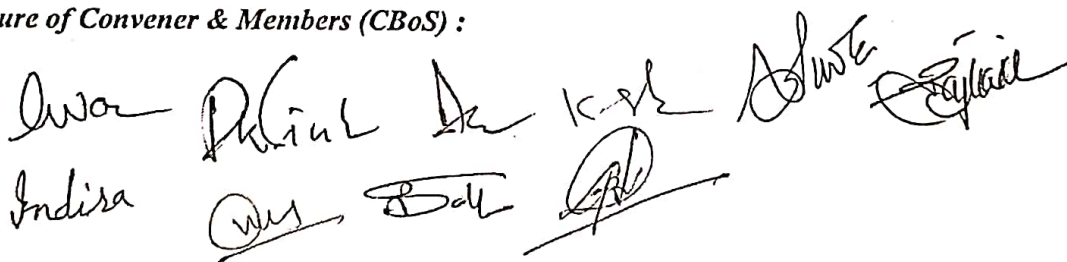
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	ozonolysis, hydroboration/oxidation. <b>Aromatic Hydrocarbons</b> Aromatic hydrocarbons: Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/ carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directive effects of the groups.	
<b>III</b>	<b>Behaviour of ideal gases:</b> Kinetic theory of gases – postulates and derivation of the equation, $PV = \frac{1}{3} mnc^2$ 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. <b>Behaviour of Real gases:</b> Deviation from ideal behaviour, derivation of van der Waals, equation of state and critical constants. <b>Liquid state chemistry:</b> structure of liquids(Eyring Theory), Properties of liquids, viscosity and surface tension. <b>Solid state chemistry:</b> 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
<b>IV</b>	<b>A. Colloids and surface chemistry:</b> 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>B. Chemical kinetics:</b> 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. <b>C. Catalysis:</b> Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristics of catalyst, Enzyme catalyzed reactions, Industrial applications of catalysis.	11
<b>Keywords</b>	<i>Acid &amp; Bases, Alkanes, Cycloalkanes, Alkenes, Dienes, Alkynes, Aromatic Hydrocarbons, Kinetic theory of gases, Real gases, Intermolecular forces, Crystal structure, Chemical kinetics</i>	

**Signature of Convener & Members (CBoS) :**


  
 Indira

**Officer-In-Charge (Academics)**  
 Shaheed Nandkumar Patel  
 Vishwavidyalaya, Raigarh (C.G.)

**Chairman**  
 Shaheed Nandkumar Patel  
 Vishwavidyalaya, Raigarh (C.G.)

## 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://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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar -	10	
	Total Marks -	30	

Officer-In-Charge (Academics)  
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Jharkhand State Open University,  
Raigarh (C.G.)

Chairman  
Jharkhand State Open University  
Shaheed Nandkumar Patel  
Raigarh (C.G.)

<b>End Semester Exam (ESE):</b>	<b>Two section – A &amp; B</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
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Name and Signature of Convener & Members of CBoS:

Anu                      \* P.K. 1/24 L                      Dr K. S. R.                      A. K. S.                      S. K. S.  
 Indira                      S. K. S.                      S. K. S.                      S. K. S.                      S. K. S.

Officer-In-Charge (Exam) :  
 Shaheed Nandkumar Patel  
 Vishwavidyalaya, Raigarh (C.G.)

Chairman  
 of Studies .....  
 Shaheed Nandkumar Patel  
 Vishwavidyalaya, Raigarh (C.G.)

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

<b>PART- A: Introduction</b>		
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)	<ul style="list-style-type: none"> <li>➤ Demonstrating and using common glassware for accurate measurements</li> <li>➤ Studying the functional group analysis organic compounds</li> <li>➤ Determining melting points to assess compound purity and employing distillation and sublimation techniques to establish boiling points</li> <li>➤ Equipping with essential skills in measuring liquid surface tension and solution viscosity</li> </ul>
6	Credit Value	1 Credits   Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50   Min Passing Marks: 20
<b>PART -B: Content of the Course</b>		
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	<b>Basic Laboratory Techniques</b> 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) <b>Functional group Analysis of Organic Compounds</b> , Detection of elements (N, S, and halogens) and functional groups <b>Physical chemistry</b> 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) :

Chairman  
 Snaheed Nandkumar Patel  
 Mahwavidyalaya, Raigarh (C.G.)

Officer-In-Charge  
 Snaheed Nandkumar Patel  
 Mahwavidyalaya, Raigarh (C.G.)



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

<b>PART- A: Introduction</b>			
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)	<ul style="list-style-type: none"> <li>➤ To know the contributions of ancient Indian scientists, study atomic structure, and periodic properties.</li> <li>➤ To explore the concept of chemical bonding, including ionic and covalent bonding, hybridization, molecular orbital theory and intermolecular interactions.</li> <li>➤ To learn about reaction mechanisms of inorganic reactions and their stoichiometry.</li> <li>➤ To understand different acid-base theories and solvent system.</li> </ul>	
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)

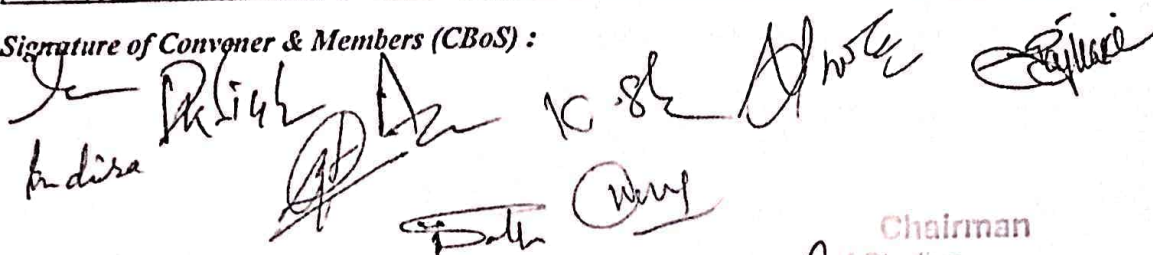
Unit	Topics (Course contents)	No. of Period
I	<p><b>A. Chemistry in Ancient India:</b> (a) Chemical techniques in ancient India: General Introduction (b) Contribution of ancient Indian scientists in chemistry, e.g., metallurgy, dyes, pigments, cosmetics, Ayurveda, Charak Sanhita.</p> <p><b>Ancient Indian Chemist- Their Contribution and Books-</b> Rishi Kanad, Acharya Nagarjuna, Vagbhatta, Govindacharya, Yashodhar, Ramchandra, Somadava, Gopalbhatta etc. Indian Chemist of 19th century- Acharya Prafulla Chandra Ray- His Contribution and work for Indian Chemistry.</p> <p><b>B. Atomic Structure and Periodic Properties:</b> (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.</p>	11
II	<p><b>Chemical Bonding – I A) Ionic Bonding:</b> General characteristics of ionic bonding. <b>Ionic Bonding &amp; Energy:</b> Lattice and solvation energies and their importance in the context of stability and solubility of ionic compounds.</p> <p><b>Born-Haber Cycle and its Applications:</b> Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules.</p> <p><b>B) Covalent Bonding:</b> 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<sub>3</sub>, H<sub>2</sub>O, SF<sub>4</sub>, ClF<sub>3</sub>, PCl<sub>5</sub>, SF<sub>6</sub>, XeF<sub>2</sub>, XeF<sub>6</sub>, XeO<sub>3</sub>, XeOF<sub>4</sub>, XeF<sub>4</sub>.</p>	12

Officer-In-Charge:  
 Shaheed Nandkumar Patel  
 Chhavidyalaya, Raigarh (C.G.)

Officer-In-Charge:  
 Shaheed Nandkumar Patel  
 Chhavidyalaya, Raigarh (C.G.)

	<p><b>Chemical Bonding - II</b></p> <p>A) MO theory: LCAO method-criteria of orbital, overlap, types of molecular orbitals-<math>\sigma</math>-, <math>\pi</math>- and, <math>\delta</math>-MOs; formation of <math>\sigma</math>- and <math>\pi</math>-MOs and their, schematic illustration; qualitative MO energy, level diagram of homo- (<math>N_2</math> &amp; <math>O_2</math>(including peroxide, superoxide) ) and hetero-diatomic molecules (<math>NO</math>, <math>CO</math>), magnetic properties, bond order and stability of molecules and ions.</p> <p>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).</p>	
III	<p><b>A. Chemical properties of s-block metals</b> 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</p> <p><b>B. Chemistry of p-Block Elements</b> <b>Boron group:</b> Hydrides (classification of boranes), Diborane (preparation, properties, and structure elucidation), Borazine (preparation and structure) <b>Carbon group:</b> Carbides (salt-like carbides, interstitial carbides, covalent carbides), Silicates (classification, three-dimensional silicates - properties and structures) <b>Nitrogen group:</b> Hydrides of Nitrogen (hydrazine, hydroxylamine, hydrazoic acid) Structure of oxides of nitrogen (<math>N_2O</math>, <math>NO</math>, <math>NO_2</math>, <math>N_2O_4</math>, and <math>N_2O_5</math>), Structure of oxyacids of nitrogen (<math>HNO_2</math>, <math>HNO_3</math>, <math>H_2N_2O_7</math>), Nitrides (classification, preparation, properties, and uses) Structure of Oxides and oxoacids of phosphorus: (<math>P_2O_3</math>, <math>P_2O_5</math>) <math>H_3PO_2</math>, <math>H_3PO_3</math>, <math>H_3PO_4</math>, <math>H_4P_2O_7</math> <b>Halogen:</b> Hydrides, Oxides and oxyacids of halogens (structure only) – Inter halogen compounds and pseudo halogens</p>	11
IV	<p><b>Electronic Effects in Organic Compounds</b> 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.</p> <p><b>B. Stereochemistry of Organic Compounds</b> i) <b>Optical Isomerism</b> Elements of symmetry, chirality, enantiomers, and optical activity, Chiral and achiral molecules with two stereogenic centers (Tartaric acid as an example), Erythro &amp; Threo, Diastereomers and meso compounds, Inversion, retention, and racemization, Relative configuration (D/L), and absolute configuration (R/S nomenclature: sequence rules). ii) <b>Geometrical Isomerism</b> Geometric isomerism (cis-trans isomerism) in alkenes with examples (maleic acid, fumaric acid, and 2-butene), E/Z system of nomenclature.</p>	11
Keywords	Ancient Indian Chemistry, Atomic Structure, Periodic Properties, Chemical Bonding, s- & p-block elements, Electronic effects, Stereochemistry	

Signature of Convener & Members (CBoS) :



Officer-In-Charge (Academics)  
Shaheed Nandkumar Patel  
Shwavidyalaya, Raigarh (C.G.)

Chairman  
of Studies .....  
Nandkumar Patel  
Shwavidyalaya, Raigarh (C.G.)





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

<b>PART- A: Introduction</b>			
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)	<ul style="list-style-type: none"> <li>➤ Analyze mixtures for cations (<math>\text{NH}_4^+</math>, <math>\text{Pb}^{2+}</math>, etc.) &amp; anions (<math>\text{CO}_3^{2-}</math>, <math>\text{S}^{2-}</math>, etc.) using <math>\text{H}_2\text{S}</math> or other methods.</li> <li>➤ Perform titrimetric analysis (standardization, unknown conc. determination).</li> <li>➤ Estimate the concentration of acetic acid in vinegar (using <math>\text{NaOH}</math>), alkali content in antacids (using <math>\text{HCl}</math>), and free alkali in soaps/detergents.</li> <li>➤ Utilize complexometric titrations for calcium (<math>\text{Ca}^{2+}</math>), water hardness, <math>\text{Fe}^{2+}/\text{Fe}^{3+}</math>, and <math>\text{Cu}^{2+}</math>.</li> </ul>	
6	Credit Value	1 Credits	Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
<b>PART -B: Content of the Course</b>			
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	<b>QUALITATIVE INORGANIC MIXTURE ANALYSIS:</b> Inorganic mixture analysis containing up to four ionic species (two cations and two anions) using $\text{H}_2\text{S}$ (hydrogen sulfide) or other appropriate methods (Excluded are interfering and insoluble salts) Cations and anions that may be encountered include: Cations: $\text{NH}_4^+$ , $\text{Pb}^{2+}$ , $\text{Bi}^{3+}$ , $\text{Cu}^{2+}$ , $\text{Cd}^{2+}$ , $\text{Fe}^{2+}/\text{Fe}^{3+}$ , $\text{Al}^{3+}$ , $\text{Co}^{2+}$ , $\text{Ni}^{2+}$ , $\text{Mn}^{2+}$ , $\text{Zn}^{2+}$ , $\text{Ba}^{2+}$ , $\text{Sr}^{2+}$ , $\text{Ca}^{2+}$ , $\text{Na}^+$ Anions: $\text{CO}_3^{2-}$ , $\text{S}^{2-}$ , $\text{SO}_4^{2-}$ , $\text{NO}_3^-$ , $\text{CH}_3\text{COO}^-$ , $\text{Cl}^-$ , $\text{Br}^-$ , $\text{I}^-$ , $\text{NO}_2^-$ , $\text{SO}_3^{2-}$ (Spot tests may be used wherever feasible.) <b>TITRIMETRIC ANALYSIS</b> Standardize sodium hydroxide solution using a standard oxalic acid solution. Determine the concentration of hydrochloric acid ( $\text{HCl}$ ) solution using standardized sodium hydroxide solution as an intermediate.		30
Keywords	Qualitative Analysis ( $\text{H}_2\text{S}$ method, Cations ( $\text{NH}_4^+$ , $\text{Pb}^{2+}$ , etc.), Anions ( $\text{CO}_3^{2-}$ , $\text{S}^{2-}$ , etc.), Titrimetric Analysis, Standardization ( $\text{NaOH}$ solution), Concentration Determination ( $\text{HCl}$ solution)		

Signature of Convenor & Members (CBoS) :

Officer-In-Charge  
 Snaheed Nandkumar Patel  
 Jyoti Vidyalyaya, Raigarh (C.G.)

Chairman  
 Snaheed Nandkumar Patel  
 Jyoti Vidyalyaya, Raigarh (C.G.)

## 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., & Dhingra, 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/3B7tOOV>
- <https://bit.ly/30V85ze>
- <https://bit.ly/3B5WOIQ>
- <https://bit.ly/3C9PXPS>
- <https://bit.ly/30Ip9rZ>
- <https://bit.ly/3BPnwgc>

#### 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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance - 05 Total Marks - 15	
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:

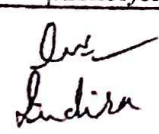
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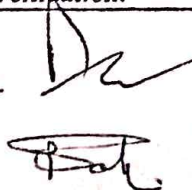
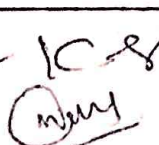
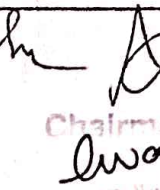
Officer-In-Charge (Acad. & Lab.)  
Shaheed Nandkumar Patel  
Ranwavidyalaya, Raigarh (C.G.)

Chairman  
*Sh*  
Shri Nandkumar Patel  
Ranwavidyalaya, Raigarh (C.G.)

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

<b>PART- A: Introduction</b>			
Program: Bachelor in Science <i>(Certificate / Diploma / Degree/Honors)</i>		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)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> <li>&gt; To understand different acid-base theories and solvent system .</li> <li>&gt; To learn the preparation, bonding, and reactions of C-C <math>\sigma</math>- &amp; <math>\pi</math>-bonded compounds</li> <li>&gt; To understand the concept and chemistry of aromatic compounds and their reactions</li> <li>&gt; To learn the basic concepts of various states of matter &amp; understand the basic concepts of surface chemistry and chemical kinetics</li> </ul>	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning &amp; Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
<b>PART -B: Content of the Course</b>			
Total No. of Teaching-learning Periods (01 Hr. per period) = 45 Periods (45 Hours)			
Unit	Topics (Course contents)	No. of Period	
I	<b>Acid, Base and Solvent System</b> 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	<b>CHEMISTRY OF C-C <math>\sigma</math>-BONDING</b> 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. <b>CHEMISTRY OF C-C <math>\pi</math>-BONDING</b> 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 $\text{KMnO}_4$ ). 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	

  
 Officer-In-Charge  
 Shahaheed Nandkumar Patel  
 Wavidyalya, Raigarh (C.G.)

  
  
  
 Chairman  
 Shahaheed Nandkumar Patel  
 Wavidyalya, Raigarh

	<p><b>Aromatic Hydrocarbons</b>  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.</p>	
III	<p><b>Behaviour of ideal gases:</b> Kinetic theory of gases – postulates and derivation of the equation, <math>PV = \frac{1}{3} mnc^2</math> 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.  <b>Behaviour of Real gases:</b> Deviation from ideal behaviour, derivation of van der Waals, equation of state and critical constants.  <b>Liquid state chemistry:</b> structure of liquids(Eyring Theory), Properties of liquids, viscosity and surface tension.  <b>Solid state chemistry:</b> 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.</p>	11
IV	<p><b>A. Colloids and surface chemistry:</b> 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>B. Chemical kinetics:</b> 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.  <b>C. Catalysis:</b> Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristics of catalyst, Enzyme catalyzed reactions, Industrial applications of catalysis.</p>	11
Keywords	<p><i>Acid &amp; Bases, Alkanes, Cycloalkanes, Alkenes, Dienes, Alkynes, Aromatic Hydrocarbons, Kinetic theory of gases, Real gases, Intermolecular forces, Crystal structure, Chemical kinetics</i></p>	
<p>Signature of Convener &amp; Members (CBoS) :</p>		

### 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.

Officer-In-Charge  
Shaheed Nandkumar Patel  
Mahavidyalaya, Raigarh (C.G.)

Chairman  
Shaheed Nandkumar Patel  
Mahavidyalaya, Raigarh (C.G.)

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://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

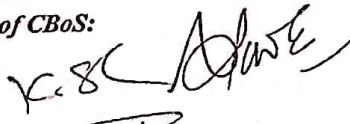

Continuous Internal Assessment (CIA): 30 Marks

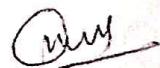
End Semester Exam (ESE): 70 Marks

<b>Continuous Internal Assessment (CIA):</b> (By Course Teacher)	Internal Test / Quiz-(2): 20 #20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10 Total Marks - 30	
<b>End Semester Exam (ESE):</b>	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 



Chairman  
of Students  
Shahed Nandkumar Patel  
Shwavidyalaya, Raigarh (C.G.)

Officer-in-Charge  
Shahed Nandkumar Patel  
Shwavidyalaya, Raigarh (C.G.)

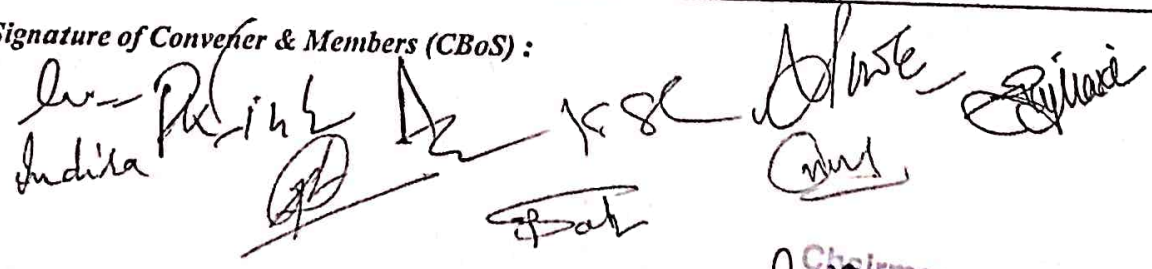
**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF CHEMISTRY**  
**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
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)	<ul style="list-style-type: none"> <li>➤ Demonstrating and using common glassware for accurate measurements</li> <li>➤ Studying the functional group analysis organic compounds</li> <li>➤ Determining melting points to assess compound purity and employing distillation and sublimation techniques to establish boiling points</li> <li>➤ Equipping with essential skills in measuring liquid surface tension and solution viscosity</li> </ul>	
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 Convefer & Members (CBoS) :



**Officer-In-Charge**  
 Shaheed Nandkumar Patel  
 Wwavidyalaya, Raigarh (C.G.)

**Chairman**  
 Shaheed Nandkumar Patel  
 Wwavidyalaya, Raigarh (C.G.)

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

Name and Signature of Convener & Members of CBoS:

Signature of Convener: *[Handwritten Signature]*  
Signature of Member: *[Handwritten Signature]*  
Signature of Member: *[Handwritten Signature]*  
Signature of Member: *[Handwritten Signature]*  
Signature of Member: *[Handwritten Signature]*  
Signature of Member: *[Handwritten Signature]*

Chairman  
of Staff  
Sh. Nandkumar Patel  
Jawahar Vidyalaya, Raigarh (C.G.)

Officer-in-Charge  
Sh. Nandkumar Patel  
Jawahar Vidyalaya, Raigarh (C.G.)



**FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)**  
**DEPARTMENT OF CHEMISTRY**  
**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)	<ul style="list-style-type: none"> <li>➤ To introduce the student about dairy product, beverages, food additives, artificial sweeteners, flavors, food colorants, paints, pigments, dyes etc.</li> <li>➤ To make aware the students about air pollution, hydrological cycle, composition of soil, fertilizers etc.</li> <li>➤ To introduce the students about carbohydrate, vitamins, drugs.</li> <li>➤ To introduce students about concept of thermodynamics used in day to day life.</li> </ul>	
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**

Total No. of Teaching-learning Periods (01 Hr. per period) - 30 Periods (30 Hours)

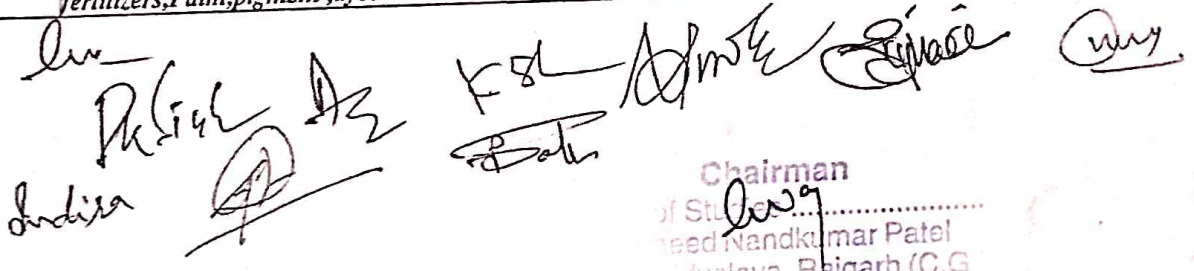
Unit	Topics(Course contents)	No. of Period
I	<p><b>Dairy Products:</b> Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk.</p> <p><b>Beverages:</b> Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, estimation of methyl alcohol in alcoholic beverages.</p> <p><b>Food additives, adulterants and contaminants:</b> Food preservatives like benzoates, propionates, sorbates, disulphites.</p> <p><b>Artificial sweeteners:</b> spartame, saccharin, dulcin, sucralose and sodium cyclamate.</p> <p><b>Flavors:</b> 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.</p> <p><b>Paints &amp; Pigments:</b> White pigments (white lead, ZnO, lithopone, TiO<sub>2</sub>). 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.</p> <p><b>Dyes:</b> 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.</p>	08
II	<p><b>Air Pollution:</b> 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.</p> <p>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).</p> <p>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.</p>	07

Indira  
 Officer-In-Charge  
 Shaheed Nandkumar Patel  
 Vidyalaya, Raigarh (C.G.)

Boh  
 Anshu  
 Chairman

Shaheed Nandkumar Patel  
 Vidyalaya, Raigarh (C.G.)

	<p>Composition of soil – inorganic and organic components in soil - micro and macronutrients.</p> <p><b>Fertilizers:</b> Classification of fertilizers - Straight Fertilizers, Compound/Complex Fertilizers, Fertilizer Mixtures. Manufacture and general properties of fertilizer products - Urea and DAP.</p>	
III	<p><b>Carbohydrates:</b> Structure, function and Chemistry of some important mono and disaccharides.</p> <p><b>Vitamins:</b> Classification and Nomenclature. Sources, deficiency diseases and structures of Vitamin A<sub>1</sub>, Vitamin B<sub>1</sub>, Vitamin C, Vitamin D, Vitamin E &amp; Vitamin K<sub>1</sub>.</p> <p><b>Drugs:</b> Classification and nomenclature.</p> <p>Structure and function of: <i>Analgesics</i> – aspirin, paracetamol.</p> <p><i>Anthelmintic drug:</i> mebendazole.</p> <p><i>Antiallergic drug:</i> Chloropheneramine maleate.</p> <p><i>Antibiotics:</i> Penicillin V, Chloromycetin, Streptomycin.</p> <p><i>Anti-inflammatory agent:</i> Oxypheno-butazone.</p> <p><i>Antimalarials:</i> Primazquine phosphate &amp; Chloroquine.</p> <p><b>Oils and fats:</b> Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like aregemone oil and mineral oils.</p> <p><b>Soaps &amp; Detergents:</b> Structures and methods of use of soaps and detergents.</p>	08
IV	<p><b>Chemical Thermodynamics:</b> 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.</p> <p>Enzyme catalyzed reactions.</p> <p><b>Principles of Reactivity:</b> 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.</p> <p><b>Chemical energy system</b> and limitations, principles and applications of primary &amp; 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.</p>	08
<b>Keywords</b>	<p><i>Air pollution, carbohydrate, vitamins, LeChattelier's law, Dairy product, artificial sweeteners, fertilizers, Paint, pigment, dyes.</i></p>	



Chairman  
 of Studies.....  
 Shaheed Nandkumar Patel  
 Jyoti Vasthaliya, Raigarh (C.G)

Officer-In-Charge (C.G.)  
 Shaheed Nandkumar Patel  
 Jyoti Vasthaliya, Raigarh (C.G.)

Signature of Convener & 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.)*. FAL.
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://onlinecourses.swayam2.ac.in/nos22_sc23/preview)

[https://www.researchgate.net/publication/343585969\\_Chemistry\\_in\\_Everyday\\_Life](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:


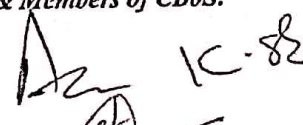
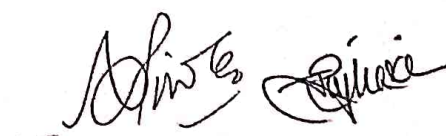
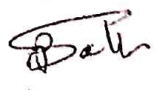
Maximum Marks: 50 Marks

Continuous Internal Assessment(CIA):15 Marks

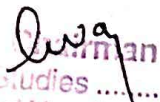
End Semester Exam(ESE):35Marks

Continuous 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
	Two section - A & B Section A: Q1. Objective - 05 x 1 = 05 Mark; Q2. Short answer type- 5 x 2 = 10 Marks Section B: Descriptive answer type qts., 1 out of 2 from each unit - 4 x 05 = 20 Marks	
End Semester Exam (ESE):		

Name and Signature of Convener & Members of CBoS:

Indira  K. S.   

Officer-In-Charge (C.G.)  
Shaheed Nandkumar Patel  
Anwavidyalaya, Raigarh (C.G.)

  
Shaheed Nandkumar Patel  
Anwavidyalaya, Raigarh (C.G.)

# FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

## DEPARTMENT OF CHEMISTRY

### COURSE CURRICULUM

<b>PART-A: Introduction</b>			
Program: Bachelor in Science <i>(Certificate / Diploma / Degree)</i>		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)	<i>As per Program</i>	
5	Course Learning Outcomes(CLO)	<ul style="list-style-type: none"> <li>➤ Understand needs, goals, and obstacles in green chemistry.</li> <li>➤ Understand and application of twelve principles of chemistry.</li> <li>➤ Design green solvents and green reactions.</li> <li>➤ To interpret and execute case study, survey, and projects on Green Chemistry.</li> </ul>	
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
<b>PART -B: Content of the Course</b>			
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	<ul style="list-style-type: none"> <li>• Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis).</li> <li>• 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.</li> <li>• Right fit pigment: synthetic azo pigments to replace toxic organic and inorganic pigments.</li> <li>• An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.</li> </ul>		30

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Jyayalaya, Raigarh (C.G.)

	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):

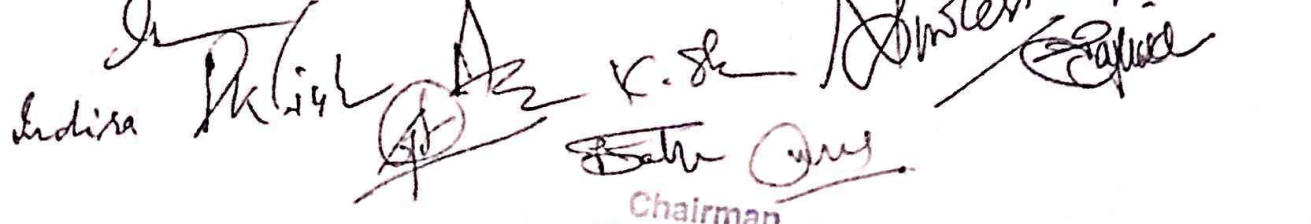
### PART-C: Learning Resources

Text Books, Reference Books and Others	
Textbooks Recommended-	
<ol style="list-style-type: none"> <li>1. Ahluwalia, V.K. (2013). <i>Green chemistry: A textbook</i>. Alpha Science International.</li> <li>2. Shukla, S., Gulati, S., &amp; Batra, S.K. (2020). <i>A textbook of green chemistry: benign by design</i>. Shree kala Prakashan.</li> <li>3. Kumar, V. (2013). <i>An introduction to green chemistry</i>. Vishal publishing Co.</li> <li>4. Lancaster, M. (2020). <i>Green chemistry: an introductory text</i>. Royal society of chemistry.</li> </ol>	
Reference books Recommended:	
<ol style="list-style-type: none"> <li>1. Perosa, A., &amp; Zecchini, F. (2007). <i>Methods and reagents for green chemistry: an introduction</i>. John Wiley &amp; Sons.</li> <li>2. Clark, J. H., &amp; Macquarrie, D. J. (Eds.). (2008). <i>Handbook of green chemistry and technology</i>. John Wiley &amp; Sons.</li> <li>3. Ameta, S. C., &amp; Ameta, R. (Eds.). (2023). <i>Green Chemistry: Fundamentals and Applications</i>. CRC press.</li> <li>4. Anastas, P. T. (Ed.). (2013). <i>Handbook of green chemistry (Vol. 1)</i>. Wiley-VCH.</li> </ol>	
Online Resources- e-Resources / e-books and e-learning portals	
<ul style="list-style-type: none"> <li>&gt; <a href="https://www.mygreenlab.org/uploads/2/1/9/4/21945752/gc_-_green_chem_guide-beyond_benign_my_green_lab.pdf">https://www.mygreenlab.org/uploads/2/1/9/4/21945752/gc - green chem guide-beyond benign my green lab.pdf</a></li> <li>&gt; <a href="https://www.organic-chemistry.org/topics/green-chemistry.shtm">https://www.organic-chemistry.org/topics/green-chemistry.shtm</a></li> <li>&gt; <a href="https://royalsocietypublishing.org/doi/10.1098/rsos.191378">https://royalsocietypublishing.org/doi/10.1098/rsos.191378</a></li> <li>&gt; <a href="https://www.gvsu.edu/labsafety/green-chemistry-99.htm">https://www.gvsu.edu/labsafety/green-chemistry-99.htm</a></li> </ul>	

### 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 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:

Indira Kishor Arora K. S. Arora  


Officer-In-Charge  
 Shaheed Nandkumar Patel  
 Jawahar Vidyalaya, Raigarh (C.G.)

Chairman  
 Shaheed Nandkumar Patel  
 Jawahar Vidyalaya, Raigarh (C.G.)