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**

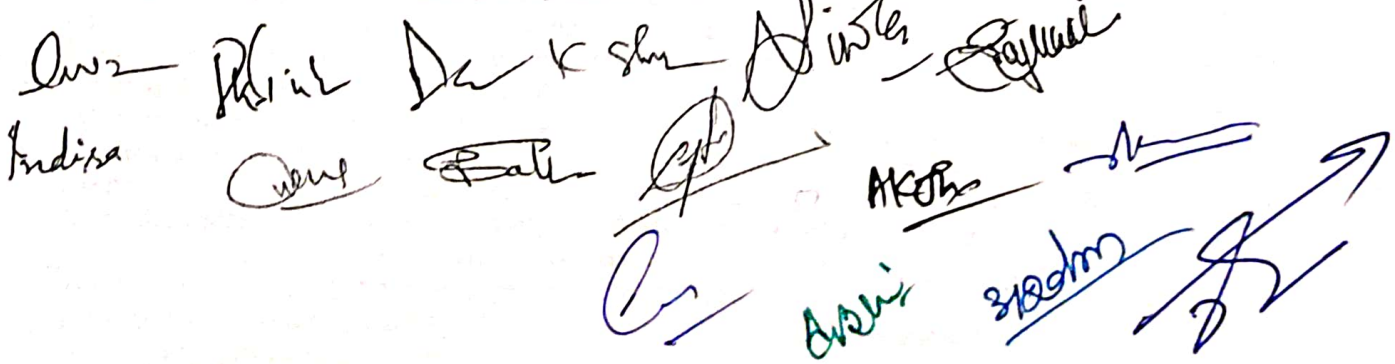
PART -D: Assessment and Evaluation

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 *(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:

Semester 4 VI (SEC)

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 otal 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: