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

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

PART -B: Content of the Course

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

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

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

Signature of Convener &Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

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

Reference Books recommended-

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

Online Resources–

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

Online Resources–

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

PART -D: Assessment and Evaluation

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

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

Name and Signature of Convener & Members of CBoS:

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

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

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

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

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

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

Reference Books Recommended:

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

Online Resources–

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

Online Resources–

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

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment(CIA): 15 Marks

End Semester Exam(ESE): 35 Marks

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

Name and Signature of Convener & Members of CBoS:

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

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

PART-B: Content of the Course

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

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

	Particulate matter, Soil and radiation pollution, Radiation Chemistry.

Signature of Convener & Members (CBoS) :

PART–C

Learning Resources: Text books, Reference Books and Others

Textbooks Recommended–

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

Reference Books Recommended–

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

OnlineResources–e-Resources/e-booksande-learningportals

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

Part-D:AssessmentandEvaluation

Suggested Continuous Evaluation Methods:

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

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

Name and Signature of Convener and Members of CBoS

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

PART- A: Introduction

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

PART-B: Content of the Course

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

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

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

Signature of Convener & Members (CBoS) :

PART–C

Learning Resources: Text Books, Reference Books andOthers

Textbooks Recommended–

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

Reference Books Recommended–

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

OnlineResources– e-Resources/e-booksande-learningportals

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

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

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

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

Name and Signature of Convener and Members of CBoS

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

PART-A: Introduction

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

PART -B: Content of the Course

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

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

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

Signature of Convener &Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended–

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

Reference books Recommended:

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

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

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

PART-D: Assessment and Evaluation

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

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

Name and Signature of Convener & Members of CBoS: