Remarks	Course	Paper(s)	Semester	Nomenclature of Paper	Credits	Hours /Week	Internal marks	External Marks	TotalMarks	Exam Duration
Scheme A,B, C & D	VOC	B23-VOC-222	IV	AgricultureChemistry	3	3	20	50	70	3 hrs.
				Practical	1	2	10	20	30	3 hrs.
Scheme A, B,C & D	VOC	B23-VOC-227	IV	GreenChemistry	3	3	20	50	70	3 hrs.
				Practical	1	2	10	20	30	3 hrs.

VOC

Session: 2023-24			
Part A – Introduction			
Subject	Chemistry		
Semester	IV		
Name of the Course	Agricultural chemistry		
Course Code	B23-VOC-222		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As perAnnexure-I	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1 Thinks about chemistry involved in agriculture 2 Know about chemical composition of soils; 3 Understand impacts of pollutions on soils and its productivity; 4 Critically think regrading sewage effluents. 5*. Practical training of soil analysis		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks: 70 + 30* Internal Assessment Marks: 20 +10* End Term Exam Marks: 50 + 20*		**Time: Theory: Three Hours Practicum: Three Hours**	
(CLO):	1 Thinks about chemistry involved in agriculture		

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting twoquestions from each SECTION and one question (Question No.1) based onentire syllabus will consist of short answer type. All questions carry equal marks. The candidate is required to attempt five questions in all selectingone from each SECTION. Question No.1 is compulsory.

Unit	Topics
I	**12 Hrs** Plants as producers: Photosynthesis, pesticides, herbicide, insecticide, fungicide, storage and preservation of agriculture produce, food processing, chemicals (alcohol) from agriculture waste, use of polymers in agriculture
II	**11 Hrs** Soil fertility and soil productivity: urea cycle, Organic and inorganic nitrogen (Haber Bosch Process), nutrient sources – fertilizers and manures; essential plant nutrients - functions and deficiency symptoms. Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.
III	**11 Hrs** Chemical (elemental) composition of the earth's crust and soils, Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity; Chemistry of salt-affected soils and amendments; soil pH, ECe, ESP, SAR and important relations; soil management and amendments.
IV	**11 Hrs** Nature and sources of pollutants acid rains, oil spills etc.; air, water and soil pollutants - their CPC standards and effect on plants, animals and human beings. Sewage and industrialeffluents – their composition and effect on soil properties/health, and plant growth and human beings; soil as sink for waste disposal.
V*	**30 Hrs** 1. pH of Soil 2. determine carbonate and bicarbonate in soil 3. Determine chloride in the soil sample 4. Determine starch in organic manure 5. Determine nitrate in the soil 6. Determine sulphate in the soil 7. To study Seed germination and viability test.
	Suggested Evaluation Methods Short Answer and MCQ Type QUESTIONS

Internal Assessment: 20+10*=30	End Term Examination: 70(50+20*)
➢ **Theory: 20** • Class Participation: 05 • Seminar/presentation/assignment/quiz/class test etc.:05 • Mid-Term Exam: 10 ➢ **Practicum:10** • Class Participation: 05 • Seminar/Demonstration/Viva-voce/Lab records etc.: 05 • Mid-Term Exam: N. A.	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ Bear RE. 1964. Chemistry of the Soil. Oxford and IBH. Bolt GH & Bruggenwert MGM. 1978. Soil Chemistry. Elsevier. Greenland DJ & Hayes MHB. 1981. Chemistry of Soil Processes. John Wiley & Sons.
- ✓ Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13 Ed. Pearson Edu.
- ✓ Kabata-Pendias A & Pendias H. 1992. Trace Elements in Soils and Plants. CRC Press.
- ✓ Kannaiyan S, Kumar K & Govindarajan K. 2004. Biofertilizers Technology. Scientific Publ.
- ✓ Leigh JG. 2002. Nitrogen Fixation at the Millennium. Elsevier.
- ✓ Mengel K & Kirkby EA. 1982. Principles of Plant Nutrition. International Potash Institute, Switzerland.
- ✓ Mortvedt JJ, Shuman LM, Cox FR & Welch RM. 1991. Micronutrients in Agriculture. 2 Ed. SSSA, Madison.
- ✓ Pierzinsky GM, Sims TJ & Vance JF. 2002. Soils and Environmental Quality. 2 Ed. CRC Press.
- ✓ Stevenson FJ & Cole MA. 1999. Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur,Micronutrients. John Wiley & Sons.
- ✓ Tisdale SL, Nelson SL, Beaton JD & Havlin JL. 1999. Soil Fertility and the Fertilizers. 5 Ed.Prentice Hall of India.
- ✓ Troeh FR & Thompson LM. 2005. Soils and Soil Fertility. Blackwell.

- ✓ Troeh FR & Thompson LM. 2005. Soils and Soil Fertility. Blackwell.

Course type-CC-M4(V)

Session: 2024-25			
Part A - Introduction			
Subject	Chemistry		
Semester	IV		
Name of Course	**Green Chemistry**		
Course Code	B-23-CHE-204		
Course Type: (MCC/CC/MDC /DSEC/VOC/DSE/PC/AEC/ VAC)	VOC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	• Understand the twelve principles of green chemistry and also build the basic understanding of toxicity, hazard and risk related to chemical substances. • Calculate atom economy, E-factor and relate them in all organic synthesis • Appreciate the use of catalyst over stoichiometric reagents. Learn to use green solvents, renewable feedstock and renewable energy sources for carrying out safer chemistry • Appreciate the use of green chemistry in problem solving skills and critical thinking to innovate and find solutions to environmental problems. • Learn to design safer processes, chemicals and products through understanding of inherently safer design (ISD) • Appreciate the success stories and real-world cases as motivation for them to practice green chemistry		
Credits	**Theory**	**Practical**	**Total**
	3	1	4

Contact Hours	45	30	75
Max. Marks:70+30* Internal Assessment Marks:20+10* End Term Exam Marks:50+20*		Time:03 + 03*	

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner is requested to set nine questions in all, selecting two questions from each SECTION and one question (Question No.1) based on entire syllabus will consist of short answertype. All questions carry equal marks. The candidate is required to attempt five questions in all selecting one from each SECTION. Question No.1 is compulsory. Log table and non-programmable calculator are allowed.

Unit	Topics
I	*Introduction* *10 Hours* Definition of green chemistry and how it is different from conventional chemistry and environmental chemistry. ➢ Need of green chemistry ➢ Importance of green chemistry in- daily life, Industries and solving human health problems (four examples each). ➢ A brief study of Green Chemistry Challenge Awards (Introduction, award categories and study about five last recent awards).
II	*Twelve Principles of Green Chemistry:* *12 Hours* The twelve principles of the Green Chemistry with their explanations, Special emphasis on the following: • Prevention of waste / byproducts, pollution prevention hierarchy. • Green metrics to assess greenness of a reaction: environmental impact factor, atom economy and calculation of atom economy. • Green solvents-supercritical fluids, water as a solvent for organic reactions, ionic liquids, solvent less reactions, solvents obtained from renewable sources. • Catalysis and green chemistry- comparison of heterogeneous and homogeneous catalysis, biocatalysts, asymmetric catalysis and photocatalysis. • Green energy and sustainability. • Real-time analysis for pollution prevention. • Prevention of chemical accidents, designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.

III	***Important Applications of Green Chemistry Principles:*** *12 Hours* Concept familiarization and application of green chemistry principles using specific examples 1. Prevention of waste/ by products; waste or pollution prevention hierarchy 2. Green metrics to assess greenness of a reaction: Calculation of atom economy of the rearrangement, addition, substitution, and elimination reactions; calculation of E-factor for industrial processes 3. Prevention/ minimization of hazardous/ toxic products 4. Safer Solvent and Auxiliaries: Problems associated with conventional reaction media Some Common Green solvents: Introduction, application, advantages, and disadvantages of green solvents in organic synthesis (taking suitable examples). Special emphasis on the following: i. Super Critical Fluids (with special reference to carbon dioxide) ii. Water: Concept of In-water, and on-water reactions (with special reference to synthesis of terpinol and linalool in water, Benzoin condensation, Heck reaction) iii. Ionic Liquids: Physical properties and classification of Ionic Liquids (with special reference to Diels Alder reaction and Coumarin synthesis in ionic liquids) iv. Biomass derived Solvents: Physicochemical properties, Use of glycerol and its derivatives (Mizoroki–Heck reaction) and 2-methyltetrahydrofuran (Suzuki–Miyaura reaction). 5. Use of renewable starting materials: Illustrate with few examples such as biodiesel, bioethanol, polymers from renewable resources (PLA from corn), Synthesis and properties of 2-Methyltetrahydrofuran, furfural and 5-Aminolevulinic acid (DALA) from levulinic acid
IV	**11 Hours** The following Real-world Cases in green chemistry should be discussed: Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments. Designing of environmentally safe marine antifoulant. Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments. An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.
V*	**30 hours** Characterization by melting point, UV-Visible spectroscopy, IR spectroscopy and any other specific method should be done (wherever applicable). 1. Preparation and characterization of nanoparticles of gold using tea leaves/silver nanoparticles using plant extracts. 2. Preparation of biodiesel from waste cooking oil and characterization (TLC, pH, solubility, combustion test, density, viscosity, gel formation at low temperature and IR can be provided). 3. Extraction of D-limonene from orange peel using liquid CO2 prepared from dry ice. 4. Mechanochemical solvent free, solid-solid synthesis of azomethine using ptoluidine and o-vanillin/p-vanillin. 5. Photoreduction of benzophenone to benzopinacol in the presence of sunlight. 6. Photochemical conversion of dimethyl maleate to dimethyl fumarate (cis-trans isomerisation)

Suggested Evaluation Methods	
Internal Assessment:20+10* ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** 50+20*

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Anastas, P.T., Warner, J.C. (2014), Green Chemistry, Theory and Practice, Oxford University Press.
2. Lancaster, M. (2016), Green Chemistry: An Introductory Text, 3rd Edition, RSC Publishing.
3. Cann, M. C., Connely, M.E. (2000), Real-World cases in Green Chemistry, American Chemical Society, Washington.
4. Matlack, A.S. (2010), Introduction to Green Chemistry, 2nd Edition, Boca Raton: CRC Press/Taylor & Francis Group publisher.
5. Alhuwalia, V.K., Kidwai, M.R. (2005), New Trends in Green chemistry, Anamalaya Publishers.
6. Sidhwani, I.T, Sharma, R.K. (2020), An Introductory Text on Green Chemistry, Wiley India Pvt Ltd.
7. Kirchoff, M.; Ryan, M.A. (2002), Greener approaches to undergraduate chemistry experiment, American Chemical Society, Washington DC.
8. Sharma, R.K.; Sidhwani, I.T.; Chaudhari, M.K. (2013), Green Chemistry Experiments: A monograph, I.K. International Publishing House Pvt Ltd. New Delhi.
9. Pavia, D.L.; Lamponam, G.H.; Kriz, G.S.W. B. (2012), Introduction to organic Laboratory Technique- A Microscale approach, 4th Edition, Brooks-Cole Laboratory Series for Organic chemistry.
10. Sidhwani I.T. (2015), Wealth from Waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated. DU Journal of Undergraduate Research and Innovation, 1(1),131-151. ISSN: 2395-2334.
11. Sidhwani, I.T; Sharma, R.K. (2020), An Introductory Text on Green Chemistry, Wiley India Pvt Ltd.
12. Monograph on Green Chemistry Laboratory Experiments, Green Chemistry Task Force Committee, Department of Science and Technology, Government of India.

Applicable for courses having practical component.