Title of the Course: Environmental Chemistry

Course Code: ESO-403 **Number of Credits:** 03

Total Contact Hours: 36 **Effective from AY:** 2022-23

Prerequisites for the course:	Graduates in any discipline with science subjects at the 10+ 2 level.	
Objectives:	1. To introduce fundamentals of environmental chemistry. 2. To provide basic knowledge of environmental pollution, effects of environmental pollutants and control measures. 3. Introduction of various experimental techniques for analysis. 4. Evaluate the utility of various analytical techniques as a qualitative and quantitative tool.	
Content:	**Module 1. Introduction** Environmental segments (Lithosphere, Hydrosphere, Atmosphere, Cryosphere and Biosphere). Biogeochemical cycles (hydrogen, carbon, nitrogen, oxygen, phosphorus, and sulphur). Introduction to Microplastics and Nanoplastics (harmful effects, preventive measures and control measures), E-waste (impact on environment, harmful effects and control measures), and Radioactivity (contamination of radioactivity, radiation hazards, control measures). **Module 2: Air pollution** Air pollutants (primary and secondary), photochemical reaction, Acid rain, Ozone layer depletion, global warming. Carbon monoxide, nitrogen oxides, sulphur dioxide and hydrocarbons (sources, harmful effects, analysis and control measures). Particulate matters (inorganic, organic and radioactive), health hazards, analysis, control devices (Gravitational settlings, particulate air filters, centrifugal separators, wet scrubbers). Case study: Bhopal gas tragedy, London and Los Angeles smog **Module 3: Water pollution** Water analysis (salinity, hardness, pH BOD, COD, colour, turbidity, taste and odour), Water pollutants: nitrates, phosphates, phenols, cyanides, heavy metals (Cd, Hg, Pb, Se, As) and analysis methods. Lake and river water treatment, municipal waste water treatment and industrial effluent treatment (from pesticides, pharmaceutical and electroplating). Case study: Kepone, Minamata **Module 4: Soil pollution** Inorganic and organic components in soil, Reactions in soil, waste pollutants in soil. Excess usage of agrochemicals, soil	06 hours 10 hours 10 hours 10 hours

	contamination with pollutants. Pesticides (toxicity, biochemical effects and control measures). Waste Management (sources and types of solid wastes, disposal techniques, collection methods, waste management approach). Case study: use of pesticides e.g. DDT	
Pedagogy:	1. Mainly lectures / tutorials. Seminars/assignments/ presentations/ self-study or a combination of some of these could also be used to some extent. 2. Pre-lab and post-lab assignments or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.	
References/ Readings	1. De, A. K. (2005). *Environmental chemistry* (3rd ed). New Age International Publishers. 2. Salker, A. V. (2017). *Environmental chemistry* (1st ed). Narosa Publishing House. 3. Sharma, B. K. (2003). *Environmental chemistry* (1st ed). GOEL Publishing House. 4. O'Neill, P. (2009). *Environmental chemistry* (3rd ed). Blackie Academic & Professional. 5. Khopkar, S. M. (2005). *Environmental pollution analysis*. (1st ed.) New Age International Publishers.	
Learning Outcomes	1. Students will be in a position to know the basic environmental chemical processes. 2. Students will be able to explain the origin and harmful effects of toxic chemicals in the environment. 3. Student will be in position to use different techniques for qualitative and quantitative estimation of environmental samples.	

Title of the Course: Green Chemistry
Course Code: ESO-404 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2022-23

Prerequisites for the course:	Graduates in any discipline with science subjects at the 10+ 2 level.	
Objectives:	1. To learn basic knowledge and principles involved in green chemistry and create awareness of greener chemistry. 2. To understand energy saving and making green processes in chemical reactions. 3. To develop social concern for waste generated from various processes.	
Content:	**Module 1: Introduction (***Ref. 1,3)* Need for Green Chemistry; Overview of twelve green chemistry principles as proposed by Paul Anastas and John Warner;	06 hours