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| **CH5501** | **Green Technology (Environment Science)** | **L-T-P: 3-0-0; Total 42 Lectures** |

***Prerequisites:*** Green Technology is a new and rapidly emerging branch of chemistry. Green Technology came into light with the goal of reducing the damage caused to the environment by man–made materials and the processes used to produce them. Green Technology could include anything from reducing waste to even disposing of waste in an appropriate manner. All chemical waste should be disposed of in the best possible manner, without causing any damage to the environment and its various life forms.

***Objectives:*** Green Technology is an approach to the design, manufacture and use of chemical products so as to reduce or eliminate chemical hazards intentionally. The goal of Green Technology is to create better, safer, chemicals while choosing the safest, most efficient ways to synthesise them. The main goal of Green Technology is to eliminate hazards right at the design stage. The principles of Green Technology demonstrate how chemical production could be achieved without posing hazard to human health and environment while at the same time being efficient and profitable.

***Course Contents:***

**Unit-I: Introduction of Green protocol:**Need, Goal and Limitation of Green Technology, Principles of Green Technology with their explanations and examples. Sustainable development, atom economy, reduction of toxicity. (5 Lectures)

**Unit II**: **Waste:**Production, Prevention, Problems and Source of waste, cost of Waste, Waste minimization technique, waste treatment and recycling. (5 Lectures)

**Unit III: Environmental chemicals:**Chemical speciation – speciation of lead, mercury, arsenic and chromium. Structure and property-activity relationship, fate of organics in the environment – transformation reactions (hydrolysis, elimination, oxidation-reduction etc).Risk evaluation of environmental chemicals, Biochemical effects of arsenic, lead, mercury and pesticides. (6 Lectures)

**Unit IV: Water and Biodegradation***:* Analysis of water and water quality parameters – concept of pH, measurement of acidity, alkalinity, hardness, residual chlorine, chlorides, DO, BOD, COD, fluoride and nitrogen.

Biodegradation – biodegradation of carbohydrates, proteins, fats and oils and detergents. (5 Lectures)

**Unit V: Atmosphere***:* Structure of atmosphere, chemical and photochemical reactions in the atmosphere. Ozone Chemistry: formation and depletion of ozone layer, oxides of nitrogen and sulphur. Acid rain mechanism of formation and effects. Photochemical smog, and sulfurous smog. Greenhouse effect, global warming, greenhouse gases. (7 Lectures)

**Unit VI: Green Synthesis and Catalysis***:* Green oxidation and photochemical reactions, Microwave and Ultrasound assisted reactions, Synthesis of Green Reagents, Green solvents.

Classification of catalysts, heterogeneous and homogeneous catalysis, bio-catalysis. (5 Lectures)

**Unit VII: Green Industrial Processes***:* Pollution statistics from various industries, polymer industry, textile industry, greener approach of dyeing, eco-friendly pesticides, pharmaceutical industry, waste water treatment. (7 Lectures)

**Unit VIII**: E-waste management. 2L

***Text:***

1. C.N Sawyer, P.L McCarty and G.F Parkin, Chemistry for Environmental Engineering and Science, 5th ed. Tata McGraw-Hill, 2003
2. Das, A. K. Environmental Chemistry with Green Chemistry, Books and allied (P) Ltd.
3. Ahluwalia, V.K. Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi, 2006.
4. Sanghi, R. and Srivastava, M.M. Green chemistry: Environment Friendly Alternatives, Narosa Publishing House.
5. Paul Anastas, John C. Warner, John Warner Joint; Green Chemistry: Theory and Practice New Ed Edition; Oxford University press, USA, 2000

***Course Outcomes:*** Green Chemists are trained to integrate this information into design of molecules to avoid or reduce toxic properties. Green Chemists also take a life cycle approach to reduce the potential risks throughout the production process. They work to ensure that a product will pose minimal amount of threat to human health and the environment during production and moreover, its disposal and reuse and at the end of its useful life. A Green Technology approach is one of continual improvement, discovery and innovation that tends to bring us even closer to processes and products that are much safer to natural ecosystem. Ultimately a product should either be able to safely degrade as a biological nutrient or it should have better recyclability.