GENERIC ELECTIVES (GE-4)

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
GREEN TECHNOLOGIES	**4**	**2**	**0**	**2**	**12th Pass**	**NIL**

Learning Objectives

- Gain insights into interdisciplinary aspects of green systems and the environment, and sustainability
- Develop a new perspective on product life cycles for improving efficiency and promoting environmental conservation
- Understand product formulation, process complexity, and infrastructure design to promote sustainability
- Integrate technical and scientific skills for environmental security and industrial sustainability for nation's development

Learning outcomes

Apply principles of green chemistry for environmentally safe products

- Design processes that rely on using environmentally benign chemicals and developing economically viable products
- Minimize environmental hazards by improved design for developing industrial products
- Using biotechnology to improve industrial methods and chemical processes as less or non hazardous, green, safe, and economically acceptable.
- Implement a combination of technical and scientific skills to understand environmental problems better, use resources, manage waste, and develop green infrastructure

SYLLABUS OF GE-4

Unit I: Green technologies (6 hours)

Definition and concepts: green technology, green energy, green infrastructure, green economy, and, green chemistry; sustainable consumption of resources; individual and community level participation such as small-scale composting pits for biodegradable waste, energy conservation; encouraged use of public transport instead of private transport; 3 R's of green technology: recycle, renew and reduce;
paradigm shift from 'cradle to cradle' to 'cradle to grave'

Unit II: Green infrastructure, planning and economy (6 hours)

Green buildings; history of green buildings, need and relevance, construction, costs and benefits; LEED certified building; Eco-mark certification: importance and implementation;

Green planning: role of governmental bodies, land use planning, concept of green cities, waste reduction and recycling in cities,
role of informal sector in waste management, public transportation for sustainable development, green belts. ; Introduction to UNEP's green economy initiative, inclusive economic growth of the society, REDD+ initiative, and cap and trade concept; green banking.

Unit III: Applications of green technologies (6 hours)

Increase in energy efficiency: Energy efficient fume hoods, motion detection lighting, or programmable thermostats. Green House Gas (GHG) emissions reduction: carbon capture and storage (CCS) technologies, purchase and use of carbon offsets, alternative forms of transportation for employees, such as carpools, fuel efficient vehicles, and mass transit, methane emissions reduction and/or reuse).Pollution reduction and removal: Physico-chemical and biological methods

Unit IV: Green chemistry (6 hours)

Introduction to green chemistry; principles and recognition of green criteria in chemistry; bioAnnexure-VII38 degradable and bio-accumulative products in environment; green nanotechnology; reagents, reactionsand technologies that should be and realistically could be replaced by green alternatives;photodegradable plastic bags**.**

Unit V: Green future (6 hours)

Agenda of green development; reduction of ecological footprint; role of green technologies towards a sustainable future; major challenges and their resolution for implementation of green technologies; green practices to conserve natural resources (organic agriculture, agroforestry, reducing paper usage and consumption, etc.); emphasis on waste reduction instead of recycling, emphasis on innovation for green future; role of advancement in science in developing environmental friendly technologies.

Practicals/Hands-on Exercise

1. Analyze practices of an industry of your choice from India and outside country that has adopted green technology for brand image and economic edge
2. Identify, explain and discuss the ecological principles adopted by the industry selected in practical 1 and analyze their importance
3. Select an industry of your choice where cleaner production is required to improve quality of life and weight its economic, social, and environmental costs
4. Recommend clean development mechanisms and methods of converting waste into wealth in an industry that plays a significant role in your native area or the nation's GDP.
5. Develop a plan for carbon credit and carbon trading where it is not prevalent so far and compare it with a similar plan from a developing or developed country
6. Conduct a Life Cycle Assessment and its elements of a product widely used in your family or residential complex and recommend methods/processes that can help achieve a green tag.
7. Compare and contrast the use of conventional and non-conventional energy sources in your state or country and devise a method for transitioning completely to complete green energy
8. Assess the types and quantity of biomass used as an energy source in your country and evolve a plan to switch towards greener methods in the next 5 years

9. Develop a feasibility status of developing and integrating solar, wind, tidal, and geothermal energy in your nation
10. Evolve an action plan for water recycling for your residential complex by considering the quantity available, type of usage, and existing infrastructure
11. Analyze a case study of commercial green building in your state and discuss the ecological principle(s) adopted for this purpose.

Suggested Readings

1. Allen, D.T., 2012. Sustainable Engineering: Concepts, Design, and Case Studies. Pearson
2. Anastas, P.T. & Warner, J.C. 1998. Green Chemistry: Theory & Practice. Oxford UniversityPress.
3. Arceivala, S.L. 2014. Green Technologies: For a Better Future. Mc-Graw Hill Publications.
4. Baker, S. 2006. Sustainable Development. Routledge Press.
5. Floyd. A., 2011. Green Building: A Professional's Guide to Concepts, Codes and Innovation. Delmar Cengage Learning
6. Hrubovcak, J., Vasavada, U. & Aldy, J. E. 1999. Green technologies for a more sustainable agriculture (No. 33721). United States Department of Agriculture, Economic Research Service.
7. Striebig, B., Ogundipe, A.A. and Papadakis, M., 2015. Engineering applications in sustainable design and development. Cengage Learning.
8. Thangavel, P. & Sridevi, G. 2015. Environmental Sustainability: Role of Green Technologies. Springer Publications.
9. Vallero, D.A. and Brasier, C., 2008. Sustainable Design: The Science of Sustainability and Green Engineering. John Wiley & Sons.
10. Woolley, T. & Kimmins, S. 2002. Green Building Handbook (Volume 1 and 2). Spon Press