OPEN ELECTIVE: SEMESTER 3: Biotechnology perspectives on sustainability and clean energy

Semester	**III**
Paper Code	**BTOE 3**
Paper Title	**Biotechnology perspectives on sustainability and clean energy**
Number of teaching hours per week	**3**
Total number of teaching hours per semester	**42**
Number of credits	**3**

Objective of the Paper: The goal of this course is to provide a comprehensive perspective on the emerging field of clean energy and sustainability. At the end of this course, students will be able to understand concepts on clean energy, types of clean energy and its resourcing, production of clean energy and managing sustainable lifestyle for a positive impact on the environment.

Course 2 : Theory: Open Elective- Biotechnology perspectives on sustainability and clean energy	**42 Hrs**
Unit 1: Sustainability and its importance	**5 hrs**
Introduction, concepts of sustainability, identifying threats for sustainability, global policies and regulations on sustainability. Current trends impacting sustainability (pollution, climate change, resource depletion, ozone depletion, human impact in various aspects, etc..). Case studies.	
Unit 2: Sustainable lifestyle	**3 hrs**
Alternatives to conventional everyday materials, a small take on plastic based pollution, concepts on sustainable fishing, aquaponics, etc	
Unit 3: Concepts of Recycling	**2 hrs**
Definition, 5R-policy, environmental impacts upon recycling. Enzyme recycling. Social responsibility for positive impact	
Unit 4: Politics of energy policy and our energy future	**2 hrs**
Political choices in energy policy globally and in the Indian context; domestic and international energy policy; energy diplomacy and bilateral ties of India with her neighbors. Current and future energy use patterns in the world and in India; evolution of energy use over time. Concept of circular economy	
Unit 5: Overview of energy and energy resources	**5 hrs**

Defining energy; forms and importance; discovery of fossil fuels, advent of nuclear energy; sources and sinks of energy; energy overconsumption in urban area; Global energy resources; renewable and non-renewable resources: distribution and availability; past, present, and future technologies for capturing and integrating these resources into our energy infrastructure; energy-use scenarios in rural and urban setups; energy conservation and management.	
Unit 6: Alternative sources for clean energy	**5 hrs**
Wind energy, solar energy, hydro energy, geothermal energy; ocean energy; biofuels; need for energy efficiency; energy conservation and sustainability; action strategies for sustainable energy mix and management from a future perspective. Carbon harvesting	
Unit 7: Solar energy devices	**3 hrs**
Solar Cell Introduction, History, Mechanism, Types of solar energy devices, materials used in making, energy efficiency.	
Unit 8: Biofuels sources and its production	**7 hrs**
Sources for biofuel, Biochemical Conversion Process, bioethanol production from different sources, biomethanol production, biogas and syngas. Algae for biofuels and challenges.	
Unit 9: Plant based materials for clean energy	**6 hrs**
Definitions, structure and composition of cellulose, lignin, hemicellulose and secondary plant cell wall polymers. Examples of synthesis procedures using plant based raw materials for clean energy.	
Unit 10: Biodiesel Production	**4 hrs**
Definition, raw materials for biodiesel production, esterification process, downstream processing of crude biodiesel, instruments/reactors involved in production.	

References

1. Elliott, D. 1997. Sustainable Technology. Energy, Society and Environment (Chapter 3). New York, Routledge Press.
2. Environmental Issues: An Introduction to Sustainability by McConnell and Abel
3. Industrial Ecology and Sustainable Engineering by TE Graedel and BR Allenby (G&A, 2nd edition 2009).
4. Allen DT and Shannord DR Sustainability Engineering: Concepts, design and case studies, Prentice Hall.
5. Photovoltaic Solar Energy Generation (ISBN: 9783540266280, by A. Goetzberger V.U. Hoffmann, Springer, 2005.
6. Biorenewable Resources: Engineering New Products from Agriculture by Robert C. Brown, Wiley-Blackwell.
7. Biomass for Renewable Energy, Fuels, and Chemicals by Donald Klass, Academic Press Publications.
8. Gasoline, Diesel and Ethanol Biofuels from Grasses and Plants by Ram B. Gupta and Ayhan Demirbas, Cambridge University Press.

9. Biofuels Engineering Process Technology by Cave Drapcho, John Nghiem, and Terry Walker, McGraw Hill Publications.
10. Textbook of Environmental Biotechnology – P K Mohapatra
11. Environmental Biotechnology – Vallero Daniel
12. Environmental Biotechnology-New Approaches and Prospective Applications- Marian Petre
13. Handouts and supplementary reading materials will be provided by the instructor