PHE 455: ENERGY STUDIES (Open elective) **[39 Hrs.]**

Learning Objectives:

- To familiarize with renewable energy resources.
- To Study conversation of Solar energy in deferent form in detail.
- To discuss Basics of the Wind energy in detail.
- To introduce Biomass energy and biogas technology.

Course Outcome (CO)

CO1 Upon successful completion, students will have the knowledge of renewable energy resources.
CO2 Will have a good understanding on conversation of Solar energy in deferent form
CO3 Will have a good understanding of Basics of the Wind energy
CO4 Scientific knowledge about biomass energy and biogas technology.

Unit I Renewable energy resources: Forms of Energy, Conservation of Energy, Nature of solar radiation, Spectral distribution of extra-terrestrial radiation, Estimation of extra-terrestrial solar radiation, Radiation on horizontal and tilted surfaces.

Conversion of Solar Energy in different forms: Various ways to convert solar energy into different forms. Solar active and passive systems, Types of solar passive systems, design aspects of solar passive systems.

Basic principle of solar photovoltaic (SPV) conversion, Block diagram of general SPV conversion system and their characteristics, different configurations, Applications (such as street light, water pumps, Radio/TV, Small capacity power generation). [13 hrs]

Unit II Basics of the Wind energy: Wind Energy Origin and classification of winds, basic principle of wind energy conversion, Extraction of maximum power from wind and its dependence on various parameters. Wind Mills, types of wind mills, Vertical axis and Horizontal axis wind mills-their performance, Merits and Demerits, Limitations of wind energy conversions. [13hrs]

Unit III Biomass energy and biogas technology: Nature of Biomass as a fuel, Properties of biomass, Biomass energy conversion processes, agriculture crop and forestry residues used as fuels, Physical, chemical and biological conversion of biomass into useful form of energy; Gasification, types of gasification Importance of biogas technology, Aerobic and anaerobic bioconversion process, Factors affecting Bio-digestion, Types of biogas plants, Applications of biogas.

Biofuels: Types of biofuels, Production processes, Biofuel applications, Ethanol as a biofuel. [13 hrs]

References

1. PeterAAdvances in energy systems and technology", (Academic Press, USA, 1986).
2. NevilleC.R.,,,Solarenergyconversion:Thesolarcell",(ElsevierNorth-Holland, 1978).
3. DixonA.E.andLeslieJ.D.,,,Solarenergyconversion",(PergamonPress,NewYork, 1979).
4. RavindranathN.H.,,,Biomass,energyandenvironment",(OxfordUniversityPress, 1995).

5. Cushion E., Whiteman A. and Dieterle G., (World Bank Report,2009).
6. TEDDY Year Book, (Tata Energy Research Institute (TERI) Publication, New Delhi, 2018).
7. World Energy Resources, Charles E. Brown, (Springer Publication), 2002.
8. Handbooks of Solar Radiation, A. Mani, (Allied Publishers), 1980.
9. Solar Energy Fundamentals and Applications, H. P. Garg and Satya Prakash, (Tata McGraw Hill), 1997.
10. Treatise on Solar Energy, H. P. Garg, Volume 1, 2 and 3, (John Wiley and Sons), 1982.
11. Principles of Solar Engineering, F. Kreith and J. F. Kreider, (McGraw Hill), 1978.
12. Principles of Solar Energy Conversion, A. W. Culp (McGraw Hill International Publication, 1991).
13. Solar Energy-Principles of Thermal Collection and Storage, S. P. Sukhatme, 2nd Edition. (Tata McGraw Hill Publication Co. Ltd.,), 1976.
14. Solar Energy Utilization, G. D. Rai, (Khanna Publishers), 1996.
15. Solar Thermal Engineering, J. A. Duffie, (Academic Press, 2013).
16. Renewable Energy Sources and Conversion Technology, N. K. Bansal, M. Kleeman and S. N. Srinivas, (Tata Energy Research Institute, New Delhi), 1996.