

Course Code	Course Name	Credits
MEDLO8043	Renewable Energy Sources	4

Objectives:

1. To study working principles of various renewable energy sources and their utilities.
2. To study economics of harnessing energy from renewable energy sources

Outcomes: Learner will be able to...

1. Demonstrate need of different renewable energy sources
2. Discuss importance of renewable energy sources
3. Discuss various renewable energy sources in Indian context
4. Calculate and analyse utilization of solar and wind energy
5. Illustrate design of biogas plant
6. Demonstrate basics of hydrogen energy

Module	Detailed Contents	Hrs.
01	Introduction to Energy Sources: Renewable and non-renewable energy sources, Need for Renewable Energy Sources, Energy Consumption as a measure of Nation's development; Strategy for meeting the future energy requirements, Global and National scenarios, Prospects of renewable energy sources, Present status and current installations, Introduction to Hybrid Energy Systems.	07
02	Solar Energy: Merits and demerits, Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length, Methods of Solar Radiation estimation. Solar Energy collection devices and Classification: Flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond, solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, Solar Photovoltaic systems & applications.	12
03	Wind Energy: Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of Aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.	10
04	Energy from Biomass: Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas.	06
05	Geothermal Energy: Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India. Energy from the ocean: Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy	08
06	Hydrogen Energy: Methods of Hydrogen production, Hydrogen Storage, Fuel Cells and Types of Fuel Cells.	05

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total **six questions, each carrying 20 marks**
- 2 **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
- 3 **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
- 4 Only **Four questions need to be solved**

Reference Books:

- 1 Non-conventional energy sources by G.D. Rai, Khanna Publishers
- 2 Renewable Energy: Power for a Sustainable Future, Edited by Godfrey Boyle, 3rd Edition, Oxford University Press
- 3 Solar Energy: Principles of Thermal Collection and Storage by SP Sukhatme and J K Nayak, TMH
- 4 Solar Energy: Fundamentals and Applications by H.P. Garg & Jai Prakash, Tata McGraw Hill.
- 5 Wind Power Technology, Joshua Earnest, PHI Learning, 2014
- 6 Renewable Energy Sources, J W Twidell & Anthony D. Weir. ELBS Pub.
- 7 Energy Conversion Systems, R D Begamudre, New Age International (P) Ltd., Publishers, New Delhi, 2000.
- 8 Solar Photovoltaics: Fundamentals, Technologies and Applications, C S Solanki, 2nd Edition, PHI Learning
- 9 Biomass Regenerable Energy, D. D. Hall and R. P. Grover, John Wiley, New York
- 10 Wind and Solar Power Systems, Mukund R Patel, CRC Press
- 11 Wind Energy Explained: Theory, Design and Application, J F Manwell, J.C. McGowan, A.L. Rogers, John Wiley and Sons
- 12 Magneto Hydrodynamics by Kuliovsky and Lyubimov, Addison