MEPE3013 NON-CONVENTIONAL ENERGY SYSTEMS (3-0-0)

Course Objective:
The objective of this course is to introduce students to the principles, working mechanisms, applications, and challenges of various non-conventional energy systems. This course aims to develop a strong understanding of alternative energy technologies, their comparative advantages, limitations, environmental impacts, and their role in achieving energy security and sustainability.
It also aims to equip students with the knowledge to apply basic design and analysis strategies of renewable energy systems and critically evaluate their feasibility from technical and economic viewpoints.

Module 1: Introduction to Energy Systems and Need for Non-Conventional Sources
The world energy demand-supply mismatch and current dependence on fossil fuels. The environmental impact of conventional energy systems and the benefits of shifting to renewable sources. Classification of renewable energy sources, their availability in India and globally, energy efficiency, and conversion potential.
Present energy scenario (India & World)
Limitations of fossil fuels
Classification and scope of renewable energy
Energy conservation and sustainability
Future energy demands and role of green energy

Module 2: Solar Energy Systems
Capturing of solar energy and converting into heat or electricity for different uses, using photovoltaic and thermal solar systems. The design, performance, advantages, and limitations of each system.
Solar radiation measurement: Solar constant, angles
Solar thermal energy: Flat plate and concentrating collectors
Solar water heating, cooking, and drying
Solar photovoltaic system: Solar cells, types, efficiency
Solar inverters, battery, applications (rooftop/grid-tied systems)

Module 3: Wind Energy Systems
Basics of wind power generation, working of wind turbines and design considerations. Wind site assessment and turbine selection based on wind profiles.
Wind characteristics and wind power equation
Types of wind turbines (HAWT vs VAWT)
Components of wind turbines
Site selection criteria and wind data analysis
Wind farm design and grid integration

Module 4: Biomass, Geothermal, Ocean, and Hydrogen Energy
Biomass and biogas energy systems for rural and industrial. Geothermal, tidal, wave, OTEC, and hydrogen fuel cell systems.
Biomass resources and energy conversion routes
Biogas plants – types and operations
Geothermal energy: Types of reservoirs, extraction methods
Ocean energy: Tidal, wave, and OTEC systems
Hydrogen energy: Production methods, fuel cells, storage

Module 5: Environmental, Economic and Policy Aspects

The policy and economic issues that affect the adoption of renewable energy technologies. The environmental impact of renewable energy sources in comparison with fossil fuels. Indian government policies, incentives, subsidies, and the role of agencies like MNRE, IREDA.

Environmental benefits of renewable energy
Emission reductions and climate change mitigation
Cost analysis and payback period calculations
Government initiatives and policies (India & global)
Barriers to implementation and future trends

Course Outcomes: By the end of this course, students will be able to:

CO1 Understand the importance of non-conventional energy sources in the current global and national energy scenario.
CO2 Describe the working principle and components of solar energy systems, including photovoltaic and thermal systems.
CO3 Analyze the fundamentals of wind energy systems, understand their site selection, and evaluate wind turbine performance.
CO4 Explain the concepts of biomass, geothermal, ocean, and hydrogen energy systems, including their processes and applications.
CO5 Assess the environmental, economic, and policy implications of using non-conventional energy resources for sustainable development.

Textbooks:

1. B.H.Khan – Non-Conventional Energy Resources, McGraw-Hill.
2. G.D.Rai – Non-Conventional Energy Sources, Khanna Publishers.

Reference Books:

1. S.P. Sukhatme& J.K. Nayak – Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw-Hill.
2. J. Twidell and T. Weir – Renewable Energy Resources, CRC Press.
3. D. Mukherjee and S. Chakrabarti – Fundamentals of Renewable Energy Systems.