Course Type	Course Code	Name of Course	L	T	P	Credit
DE	**NMED532**	**Green energy**	3	0	0	3

Course Objectives

- To make the students accustomed to estimating different green energy sources.
- To deliver mathematical steps towards the design of green energy machines.
- To deliver the concept of implementation of a hybrid power plant incorporating multiple green energy devices.

Learning Outcomes

Upon successful completion of this course, students will:

- have knowledge about green energy principles.
- learn the design of green energy machines.
- learn the design of green energy power plant and its economics.
- beenable to perform innovative research in green energy.

Unit No.	Topics to be Covered Lecture	Lecture Hours	Learning Outcomes
1	Green Energy for Sustainability and Energy Security: composition and impacts, diversification and localization of energy system, position of green energy within renewable energy domain, energy and exergy analysis of green energy system	2	To introduce various green energy systems
2	Wind turbine: classification, structural design, working principle, power generation equation, Linear momentum theory: Belz limit, airfoil concept, performance of turbine: power coefficient, torque coefficient, tip speed ratio, Analysis of wind speed data, wind speed distribution functions, Variable speed wind turbines	7	The understanding of wind turbines harnessing energy from *compressible* flow. Students will be able to solve problems in the design of wind turbines.
3	Hydrokinetic turbine: classification, working principle, power generation equation, design and performance, establishing a low/ ultra head power plant	4	The understanding of low/ultra head hydro turbines harnessing energy from *fluid* flow.
4	Tidal Turbine: classification, wave principles, working principle of turbine, power generation equation, design and performance, establishing a tidal power plant	4	Students will be able to solve problems in the design of tidal turbines.
5	Ocean thermal energy conversion: Principle, heat exchangers, pumping requirements, application, and devices.	3	The understanding of harnessing thermal energy from the *ocean*.
6	Solar energy devices: The solar resources, sun-earth geometry, orientation of solar panel, solar spectrum, and air mass, wave-particle duality of light, Photovoltaic energy conversion, Operation of a solar cell: Silicon solar cell, Performance photovoltaic modules, Design of photovoltaic modules and system, Solar thermal devices. Performance of solar thermal system.	6	Design and understanding of harnessing solar energy. Students will be able to solve problems in the design of solar photovoltaic systems.
7	Green Hydrogen: Thermodynamics of hydrogen energy conversion, kinetics of hydrogen absorption and	5	Understanding of hydrogen energy conversion and its application in

	desorption, nano processing of solid-state hydrates, high-capacity hydrides		industry.
8	Geothermal energy: Geophysics, dry rock and hot aquifer analysis, Harnessing geothermal resources	5	Understanding of geothermal energy conversion.
9	Hybrid power plant: Design of hybrid energy power plant: combination of green energies, Storing of energy, techno- economics analysis, Operation and maintenance cost, component sizing, Software description to estimate power plant costs.	6	Students will be able to solve problems on the economics of hybrid power plants.
	Total	42 hrs	

Text Books:

1. Xianguo Li, "Green energy- Basic concepts and fundamentals", Springer-Verlag, 2011

2. S. Pugalendhi, J. Gitanjali, R. Shalini, P. Subramanian- Handbook on Renewable energy and Green technology, CRC Press, 2024

Reference books

1. J. Twidell and T. Weir, "Renewable Energy Resources", E & F N Spon Ltd, London, 1986.

2. BelaLiptak, "Post oil energy technology", CRC Press, 2009

3. UmakantaSahoo, "A polygeneration process concept for Hybrid Solar and Biomass Power Plant", Wiley, 2018

4. Martin Kaltschmitt, Wolfgang Streicher, Andreas Wiese, "Renewable Energy Technology Economics and environment", Springer, 2007

8. Bent Sorensen – "Renewable Energy-Its physics, engineering, use, environmental impacts, economy and planning aspects"-Academic Press, 1997