Course Code	Course Name	Credits
26PH916	PHYSICS OF RENEWABLE ENERGY SYSTEM	04

Course Objectives

- To acquire the fundamental knowledge on different types of renewable energy resources and storage systems
- To understand the basic concept of different forms of energy conversion.
- To apply the fundamental concept of physics to different energy conversion devices.
- To identify the merits and demerits of different renewable energy resources.
- To analyse the various forms of energy resources based on its reliability and economic aspects.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Understand the basic principles of various renewable energy sources such as solar, biomass, wind, wave, and geothermal energy.
- Explain the working and applications of different renewable energy technologies and systems.
- Analyze the performance and efficiency of renewable energy devices and conversion methods.
- Evaluate the feasibility and environmental impact of different renewable energy sources.
- Apply appropriate energy storage methods and propose sustainable energy solutions for real-world needs.

Unit 1 - Direct Solar Energy (12 Hrs.)

Solar Energy supply - History of solar energy utilization - Technologies based on capture of heat from sunlight - Solar water heating system - Solar cookers - Solar steam generating system for cooking - Passive solar heating / cooling of buildings - Solar air conditioning - Solar refrigeration – Solar desalination - Salt production and solar ponds - Crop drying - Technologies for converting solar energy to electricity - Heat engines: Concentrated solar thermal energy systems - Photovoltaics.

Unit 2 – Biomass Energy (12 Hrs.)

Composition of biomass - Sources of biomass for energy generation - Food crops - Hydrocarbon - rich plants - Waste - Weed and Wild growths - Lignocellulosic biomass: Fast-growing greases and woody species - Technical routes for obtaining different types of fuels from biomass - Thermochemical conversion of biomass - Biochemical processing - Emerging technologies.

Unit 3 - Wind and Wave Energies (12 Hrs.)

Using the wind and power in the wind - Design of windmills - Summary of wind electric energy systems - Wind turbine sizes - Wind sites and properties - Storage - Wave energy generation - Potential energy - Kinetic energy - Wave energy conversion devices - Wave energy conversion by floats - High-level reservoir wave machine - Dolphin-type wave power machine - other wave machines - Advantage and disadvantages of wave energy. Ocean thermal energy conversion.

Unit 4 – Geothermal Energy (12 Hrs.)

Origin and nature of geothermal energy - Energy extraction - High-enthalpy geothermal aquifers – Low enthalpy reserves - Wet steam systems - Dry steam systems - Limitations.

Unit 5 - Storage of Renewable Energy (12 Hrs.)

Energy storage systems - Storage as electrical energy - Storage as mechanical energy - Storage as chemical energy - Storage as thermal energy.

Reference Books:

1. Tasneem, A., &Abbasi, S.A. (2010). Renewable Energy Sources. PHI Learning Private Limited New Delhi.
2. Tiwari and Ghosal (2007), Renewable energy resources, Narosa Publishing House.
3. Ramesh R & Kumar K.U (2004), Renewable Energy Technologies, Narosa Publishing House.
4. Rai G.D. (2011), Non-Conventional Energy Sources, Khanna Publishers.
5. Twidell&Wier (2011), Renewable Energy Resources, CRC Press (Taylor & Francis).

Websites and eLearning Sources:

1. https://www.un.org/en/climatechange/what-is-renewable-energy
2. https://www.nrdc.org/stories/renewable-energy-clean-facts

COs and Bloom's Taxonomy Mapping – 26PH916		
Course Outcomes	**On successful completion of this course, students will be able to**	**BTL**
CO1	Recall and explain the basic concepts of solar energy systems, biomass composition, wind, wave, and geothermal energy sources.	K1, K2
CO2	Apply principles of renewable energy technologies such as solar heating, photovoltaic systems, biomass conversion, and wind energy systems.	K3
CO3	Analyze the performance of renewable energy systems including wind turbines, wave energy devices, and geothermal systems.	K4
CO4	Evaluate different energy conversion and storage techniques for efficiency, feasibility, and environmental impact.	K5
CO5	Design and propose renewable energy solutions incorporating suitable energy sources and storage systems.	K6

BTL (Bloom's Taxonomy Level) - K1 – Remembering, K2 – Understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6 - Create

Relationship Matrix – 26PH916													
Course Outcomes	**Programme Outcomes (POs)**						**Programme Specific Outcomes (PSOs)**						**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	
CO1	3	2	1	1	1	2	3	2	1	1	1	1	1.75
CO2	3	3	2	2	2	2	3	3	2	2	2	1	2.25
CO3	2	3	3	3	2	2	2	3	3	2	2	2	2.42
CO4	2	3	2	2	2	3	2	2	3	2	2	2	2.25
CO5	2	2	3	2	3	3	2	2	3	3	3	2	2.50
												Total	2.23

Mean Score: 3- High, 2- Medium/Moderate, 1-Low