RENEWABLE ENERGY RESOURCES

Course Code	23EE4501B	Year	III	Semester	I
Course Category	PE-I	Branch	EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Power Systems - I
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the fundamentals, significance, and working principles of various renewable energy sources. (L2)
CO2	**Apply** appropriate concepts to analyze the components and operations of solar, wind, and ocean energy systems. (L3)
CO3	**Illustrate** the processes and technologies involved in biomass, geothermal, hydel, and hydrogen energy systems. (L3)
CO4	**Analyze** the potential, advantages, and limitations of emerging energy technologies such as fuel cells, MHD, and storage systems. (L4)
CO5	Work effectively in a team and communicate technical information related to renewable energy systems through reports and presentations.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
C02	3		1									1	3	2
CO3	3		1									1	3	2
CO4		3	1									1	3	2
C05									3	3				

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**SOLAR ENERGY** Overview of Solar Energy – Classification and significance of renewable energy sources, solar radiation at the Earth Surface - Equivalent circuit of a Photovoltaic (PV) Cell - I-V & P-V Characteristics - Solar Energy Collectors: Flat plate Collectors, concentrating collectors - Solar Energy storage systems and Applications: Solar Pond - Solar water heating.	**CO1, CO2, CO4, CO5**
II	**WIND ENERGY** Introduction - basic Principles of Wind Energy Conversion, the nature of Wind - the power in the wind - Site selection considerations - basic components of Wind Energy Conversion Systems (WECS) - Classification – Applications,	**CO1, CO2, CO5**

	Advantages and disadvantages of WECS.	
III	**BIOMASS, HYDEL AND GEOTHERMAL ENERGY** **Biomass:** Introduction – Biomass resources-Biomass conversion technologies-Factors affecting Bio digestion. **Hydro plants:** Basic working principle – Classification of Small Hydropower Stations-Advantages and disadvantages of small hydro plants. **Geothermal Energy**: Introduction, Geothermal Sources – Applications - operational and Environmental problems.	**CO1, CO3, CO5**
IV	**ENERGY FROM OCEANS, WAVES & TIDES:** **Oceans:** Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC in India. **Waves:** Introduction – Advantages and disadvantages of Wave energy - Wave Energy conversion devices. **Tides:** Basic principle of Tide Energy -Components of Tidal Energy- Advantages and limitations of tidal power generation	**CO1, CO2, CO5**
V	**CHEMICAL ENERGY SOURCES** **Fuel Cells**: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells - Applications. **Hydrogen Energy:** Introduction - Methods of Hydrogen production - Storage and Applications **Magneto Hydro Dynamic (MHD) Power generation:** Principle of Operation - Types.	**CO1, CO3, CO4, CO5**

Learning Resources
Text Books:
1. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011. 2. John Twidell& Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013.
Reference Books:
1. S.P.Sukhatme&J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011. 2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013. 3. ShobaNath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015.
E-Resources:
1. https://archive.nptel.ac.in/courses/103/103/103103206 2. https://archive.nptel.ac.in/courses/103/107/103107157