

COURSE CODE: 1154EE104	COURSE TITLE: <b>RENEWABLE ENERGY SYSTEMS</b>	L	T	P	C
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**COURSE CATEGORY:**

University Elective

**PREAMBLE :**

This course focuses on the new renewable energy based electric energy generation technologies and their integration into the power grid. The principals of new energy based distributed generation technologies: solar, wind, and fuel cells.

**PREREQUISITE COURSES:**

- Basic Electrical & Electronics Engineering

**RELATED COURSES:**

Power plant engineering

**COURSE EDUCATIONAL OBJECTIVES:**

The objectives of the course are to make the students,

- Introduce about the renewable energy sources like wind, solar and wave energy.
- Impart knowledge about the environmental friendly energy production and consumption.
- Explain about energy-efficient systems and products for various applications.

**COURSE OUTCOMES :**

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain about Renewable Energy resources and importance.	K2
CO2	Outline the process of photovoltaic power generation.	K2
CO3	Outline the process of power generation using wind energy sources.	K2
CO4	biomass and biogas production techniques.	K2
CO5	Explain the fundamentals and applications of Geothermal energy, tidal energy, MHD and fuel cells.	K2

**CORRELATION OF COs AND POs**

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											L	L
CO2		H	H					M	M			
CO3		H										
CO4			H		H	L	H				L	L
CO5		L			L			M	M		L	L

<b>COURSE CONTENT:</b>		
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>
World energy use-reserves of energy resources-energy cycle of the earth-environmental aspects of energy utilization-renewable energy resources and their importance.		
<b>UNIT II</b>	<b>SOLAR ENERGY</b>	<b>9</b>
Basic concepts, solar thermal systems and solar ponds, solar thermal central receiver systems, heliostats, heat transport system, thermal storage systems, photovoltaic energy conversion, solid - state principles, semi- conductors, solar cell, batteries, satellite solar power systems.		
<b>UNIT III</b>	<b>WIND ENERGY</b>	<b>9</b>
Principles of wind power, wind turbine operation, site characteristics, horizontal and vertical axis types, new developments, small and large machines, magnus effect, design principles of wind turbine, storage systems.		
<b>UNIT IV</b>	<b>BIOMASS AND BIOGAS</b>	<b>9</b>
Concepts and systems, biomass production, energy plantation, short rotation species, forestry system, biomass resource agro forestry wastes, municipal solid wastes and agro processing industrial residues, environmental factors and biomass energy development, combustion, pyrolysis, gasification and liquefaction, modeling, appliances and latest development, bioconversion: biogas, fermentation and wet processes, chemicals from biomass and biotechnology.		
<b>UNIT V</b>	<b>OTHER RENEWABLE ENERGY SOURCES</b>	<b>9</b>
Geothermal energy, types, systems and application, Ocean thermal energy, types, systems and applications. Wave energy - types, systems and applications. Tidal energy - types, systems and applications. Magneto Hydrodynamic system (MHD). Fuel cells – types and applications, hydrogen technologies. Micro-hydel systems. Hybrid systems and applications.		
<b>TOTAL: 45 PERIODS</b>		
<b>TEXT BOOKS:</b>		
<ol style="list-style-type: none"> <li>1. Rai G D, "Non Conventional Sources Of Energy", Khanna Publishers, 2006</li> <li>2. Sukhatme S P and Nayak J K, "Solar Energy - Principles of Thermal Collection and Storage", Tata McGraw Hill, 2008.</li> <li>3. Kothari P, K C Singal and Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Pvt. Ltd., New Delhi, 2008.</li> </ol>		
<b>REFERENCE BOOKS:</b>		
<ol style="list-style-type: none"> <li>1. Frank Kreith and Yogi Goswami D, "Handbook of Energy Efficiency and Renewable Energy", CRC Press, 2007.</li> <li>2. Bent Sorensen, "Renewable Energy", Academic Press, 2004.</li> <li>3. Abbasi S A and Naseema Abbasi, "Renewable Energy Sources and their Environmental Impact", PHI Private Limited, 2001.</li> <li>4. Wakil M M H, "Power Plant Technology", McGraw Hill, 1984.</li> </ol>		