

25UEET411	RENEWABLE ENERGY SOURCES	Category	L	T	P	R	Credit	Year of Introduction
		PEC	3	0	0	0	3	2025

Preamble: This course provides an understanding of the current energy scenario, energy sources, and their utilization, while addressing present and future energy needs. It also covers the principles of renewable energy conversion systems and emphasizes the importance of energy conservation for sustainable development.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Describe the environmental aspects of renewable energy resources in comparison with various conventional energy systems.	K2 Understand
CO2	Apply the principles of solar energy to identify and use the components involved in electrical energy production.	K3 Apply
CO3	Explain the concept of biomass energy resources and the conversion principles of tidal energy.	K2 Understand
CO4	Apply the concepts of renewable thermal energy and green energy to identify suitable energy sources for different applications..	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	-	1	1	-	-	-	2	3	2
CO2	3	3	-	-	-	2	1	-	-	-	2	3	3
CO3	3	3	-	-	-	2	2	-	-	-	2	3	3
CO4	3	3	-	-	-	1	2	-	-	-	2	3	2
Avg	3	3	-	-	-	1.5	1.5	-	-	-	2	3	2.5

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	-	-	*	*	*
CO2	*	*	*	*	-	-	*	*	*
CO3	*	*	*	*	-	-	*	*	*
CO4	*	*	*	*	-	-	*	*	*

Wks Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	-	-	*	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance	: 5 marks
Continuous Assessment Test	: 20 marks
Continuous Assessment Assignment	: 15 marks

SYLLABUS

Module 1 (11 Hours)

Introduction: Principles of renewable energy; energy and sustainable development, fundamentals and social implications. Worldwide renewable energy availability, renewable energy availability in India, types of renewable energy.

Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind (numerical problems); major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS Horizontal axis- single, double and multi-blade system. Vertical axis - Savonius and Darrieus types.

Module 2 (11 Hours)

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements - Pyrheliometers, Pyranometer, Sunshine Recorder. Solar Thermal systems: concentrating and non-concentrating collectors- Flat plate collectors; Solar tower electric power plant. Photovoltaic system for electric power generation – Classification of PV system -Principle of Solar cell, advantages, disadvantages and applications of solar photovoltaic system.

Module 3 (10 Hours)

Biomass Energy: Introduction; Principle of biomass energy generation - Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome type biogas plant; Urban waste to energy conversion; Biomass gasification (Downdraft). Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, classification of tidal power plants - harnessing tidal energy, advantages and limitations.

Module 4 (10 Hours)

Ocean Thermal Energy Conversion: Principle of working, classification, OTEC power stations in the world, environmental impacts associated with OTEC. Introduction to geothermal energy
Green Energy: Introduction, Fuel cells: Classification of fuel cells Hydrogen energy; Operating principles, Zero-energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.

Text Books:

1. G. D. Rai. (2023). *Non-conventional energy sources* (4th ed.). Khanna Publishers.
2. Thomas E. Kissell., David M. Buchla., & Thomas L. Floyd. (2017). *Renewable energy systems*. Pearson.
3. G. S. Sawhney. (2012). *Non-conventional energy resources*. PHI Learning.

Reference Books:

1. Tiwari, G. N. (2002). *Solar energy: Fundamentals, design, modelling and applications*. Narosa Publishers.
2. Earnest, J., & Wizelius, T. (2011). *Wind power plants and project development*. PHI Learning.
3. Sab, S. L. (1995). *Renewable and novel energy sources*. MI Publications.
4. Sawhney, G. S. (2012). *Non-conventional energy resources*. PHI Learning.
5. Tiwari, G. N. (2002). *Solar energy: Fundamentals, design, modelling and applications*. CRC Press.
6. Saigh, A. A. M. (Ed.). (1977). *Solar energy engineering*. Academic Press.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER (STC 2025 SCHEME)

Course Code	25UEET411
Course Name	RENEWABLE ENERGY SYSTEMS
Max. Marks: 60	Duration: 2.5 Hours

Part A

<i>(Answer all questions. Each question carries 3 marks)</i>				
Qn No.	Question	Marks	CO	BL
1	Describe the relationship between energy and sustainable development.	3	1	L2
2	Differentiate between Horizontal Axis Wind Turbines (HAWT) and Vertical Axis Wind Turbines (VAWT).	3	1	L2
3	Apply the concept of solar radiation estimation to explain why inclined solar panels are preferred over horizontal panels in many installations.	3	2	L3
4	Select a suitable solar collector (concentrating or non-concentrating) for a given application and justify your choice.	3	2	L3
5	Illustrate the working of a fixed dome biogas plant with a neat sketch.	3	3	L2
6	Outline the fundamental characteristics of tidal power.	3	3	L2
7	Apply the principles of open-cycle and closed-cycle OTEC systems to identify their suitable applications.	3	4	L3
8	Demonstrate the production of hydrogen using the electrolysis method.	3	4	L3
Part B <i>(Answer any one full question from each Module. Each carry 9 marks)</i>				
Module 1				
9	Explain the different types of renewable energy sources and their significance in meeting future energy demands.	9	1	L2
OR				
10	Derive the expression for power available in wind and explain the factors influencing wind power generation.	9	1	L2
Module II				
11	A flat plate collector of area 4 m ² receives solar radiation of 850 W/m ² . If the collector efficiency is 50%, compute the useful heat output and explain the working of the collector.	9	2	L3
OR				

12	A PV array consists of 10 modules, each rated at 250 W. Compute the total power output of the array and discuss its application in a standalone solar power system.	9	2	L3
Module III				
13	Describe the principle and operation of biomass gasification. Explain the working of a downdraft gasifier with a neat diagram.	9	3	L2
OR				
14	Explain the classification of tidal power plants and describe the working of each type with suitable diagrams.	9	3	L2
Module IV				
15	Apply the working principle of Ocean Thermal Energy Conversion (OTEC) to explain the operation of an OTEC power plant and classify different OTEC systems with neat sketches.	9	4	L3
OR				
16	Demonstrate the application of fuel cells and hydrogen energy technologies in implementing zero-energy concepts for sustainable energy systems.	9	4	L3