

# Renewable Energy Resources (ROE701)

**Credits:** L: 3 T: 0 P: 0

**Pre-requisite(s):** Basics of Physics, Chemistry and Mathematics

**Course Objectives:** This course enables the students

1.	To understand the difference between the non-renewable energy system and the renewable energy systems.
2.	To lay the groundwork for subsequent studies in the fields of renewable energy sources.
3.	To understand the working principles related to different renewable energy systems.
4.	To perform various calculations involved in the renewable energy systems operations and to solve different problems.
5.	To develop an intuitive understanding of the applications of different renewable energy sources like solar, wind geothermal, ocean thermal, biomass etc.

**Course Outcomes:** After the completion of this course, students will be able to

CO1	Outline the various sources of energy.
CO2	Understand the working principle of photo-voltaic system and different solar thermal energy systems.
CO3	Understand the different systems of geothermal energy extraction and wind power plants.
CO4	Demonstrate the working principles of magneto-hydrodynamics, fuel cells, thermo-electrical and thermionic conversions.
CO5	Understand the working principle of biomass, ocean thermal, wave and tidal energy systems.

## SYLLABUS

MODULE	LECTURE HOURS
<b>Module– I</b> <b>Introduction:</b> Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. <b>Solar Cells:</b> Theory of solar cells, solar cell materials, solar cell array, solar cell power plant, limitations.	8
<b>Module– II</b> <b>Solar Thermal Energy:</b> Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.	8
<b>Module– III</b> <b>Geothermal Energy:</b> Resources of geothermal energy, thermodynamics of geo-thermal energy conversion- electrical conversion, non-electrical conversion, environmental considerations. <b>Magneto-hydrodynamics (MHD):</b> Principle of working of MHD Power plant, performance and limitations. <b>Fuel Cells:</b> Principle of working of various types of fuel cells and their working, performance and limitations.	8
<b>Module– IV</b> <b>Thermo-electrical and Thermionic Conversions:</b> Principle of working, performance and limitations. <b>Wind Energy:</b> Wind power and its sources, site selection criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics, performance and limitations of energy conversion systems.	8
<b>Module– V</b> <b>Bio-mass:</b> Availability of bio-mass and its conversion theory. <b>Ocean Thermal Energy Conversion (OTEC):</b> Availability, theory and working principle, performance and limitations. <b>Wave and Tidal Wave:</b> Principle of working, performance and limitations. Waste Recycling Plants.	8

**Books recommended:**

**Text Books:**

1. D. S. Chauhan, “Non-conventional Energy Resources” New Age International.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.

**Reference Books:**

3. M. V. R. Koteswara Rao, “Energy Resources: Conventional & Non-Conventional” BSP Publications, 2006.
4. C. S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.
5. Peter Auer, “Advances in Energy System and Technology”. Vol. 1 & II Edited by Academic Press.
6. Godfrey Boyle, “Renewable Energy Power For A Sustainable Future”, Oxford University Press

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure Direct Assessment**

Assessment Tool	% Contribution during CO Assessment
1. Quiz and Assignments	20
2. Mid Semester Examination	60
3. Attendance	20
4. Teacher's Assessment (1+3)	40
5. End Semester Examination	100

**Indirect Assessment**

- Students' Feedback on Course Outcome.

**Mapping of Course Outcomes onto Program Outcomes**

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	1	1	1		3	3	1	1	1		1	1	1	2
CO2	3	2	2	2	1	3	3	2	2	1		1	2	2	3
CO3	3	2	2	2	1	3	3	2	1	1		1	3	2	3
CO4	3	2	2	2	1	3	3	2	1	1		1	3	2	3
CO5	3	2	2	2	1	3	3	2	1	1		1	2	2	3

**Correlation Levels 1, 2 or 3 as defined below:**

1: Slight (Low)      2: Moderate (Medium)    3: Substantial (High)

**Mapping between COs and Course Delivery (CD) methods**

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD5, CD7, CD8
CD3	Seminars	CO3	CD1, CD2, CD5, CD7, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD5, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD5, CD7, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		