

Program : Diploma in Mechanical Engineering / Tool and Die Engineering / Manufacturing Technology / Wood and Paper Technology	
Course Code : 6022C	Course Title: Renewable Energy Technologies
Semester : 6	Credits: 4
Course Category: Open Elective	
Periods per week: 4 (L: 3 T: 1 P: 0)	Periods per semester: 60

Course Objectives:

- To familiarize with present and future energy scenario of the world.
- To explain various methods of solar energy harvesting.
- To identify various wind energy systems and appropriate methods for Bio energy generations from various Bio wastes.
- To identify different available non-conventional energy sources for a location.

Course Prerequisites:

Topic	Course code	Course name	Semester
Basic knowledge in Energy		Thermal engineering	4
		Power Plant Engineering	5

Course Outcomes:

On completion of the course, the students will be able to:

CO _n	Description	Duration (Hours)	Cognitive Level
CO1	Explain the different energy sources and conservation methods, present as well as future scenario of world energy use and economics of renewable energy systems	15	Understanding
CO2	Explain various methods of solar energy harvesting.	14	Understanding
CO3	Describe the basic features and applications of wind and bio energy	15	Understanding

CO4	Explain different available non-conventional energy sources.	14	Understanding
	Series Test	2	

CO-PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	-	-	-	3	-	2
CO2	3	-	-	-	3	-	2
CO3	3	-	-	-	3	-	2
CO4	3	-	-	-	3	-	2

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module outcomes	Description	Duration (Hours)	Cognitive Level
CO1	Explain the different energy sources and conservation methods, present as well as future scenario of world energy use and economics of renewable energy systems.		
M1.01	Introduction to Energy Sources. Understand the World Energy Use, Reserves of Energy Resources. Identify the Environmental Aspects of Energy Utilisation. Identify the Renewable Energy Scenario in India and around the World. Identify Major sources of energy. Renewable and Non-renewable. Define Primary and Secondary energy. Identify the Prospects of alternate energy sources. Identify the Need of alternate energy sources.	5	Understanding
M1.02	List the Energy Conservation Techniques List the Principles of energy conservation.	5	Understanding

	Define Energy audit and give its classifications Define Cogeneration and its application Define Combined cycle system		
M1.03	Explain the Concept of energy management Explain the different energy management techniques like Analysis of input, Reuse and recycling of waste, Energy education, Conservative technique and energy audit.	5	Understanding

Contents:

World Energy Use, Reserves of Energy Resources, and, Environmental Aspects of Energy Utilization. Renewable Energy Scenario in India and around the World. Economics of renewable energy systems. Energy Sources, Major sources of energy - Renewable and Non-renewable - Primary and Secondary energy sources. Need of alternate energy sources. Energy Conservation Techniques. Distribution of energy consumption - Principles of energy conservation. - Energy audit - classifications - Cogeneration - application - Combined cycle system. Concept of energy management. Energy management techniques.

CO2	Explain various methods of solar energy harvesting.		
M2.01	Define Solar Radiation. Understand Solar radiations at earth's surface. Understand Solar Radiation Geometry: Define Declination, Hour angle, altitude angle, incident angle, zenith angle, and solar azimuth angle.	6	Understanding
M2.02	Explain Principle of conversion of solar energy into heat and electricity. Explain Photovoltaic electric conversion. Explain the Construction and working of typical flat plate collector and solar concentrating collectors and their applications.	4	Understanding
M2.03	Explain the Applications of solar energy. Space heating and cooling, solar distillation, Solar cooking and furnace, solar pumping and Green house. Agriculture and Industrial process heat. (No derivations and numerical). Illustrate the solar Power Stations and solar desalination plants List.	4	Understanding
	Series Test-I	1	

Contents:

Solar radiations at earth's surface - solar radiation geometry - declination - hour angle -

altitude angle - incident angle - zenith angle - solar azimuth angle - principle of conversion of solar energy into heat and electricity - construction and working of typical flat plate collector and solar concentrating collectors - applications - solar energy - applications - space heating - cooling - photovoltaic electric conversion.

Solar distillation solar cooking - furnace -green house - agriculture industrial process heat. (no derivations and numerical) - solar power stations - solar desalination plants.

CO3	Describe basic features and applications of wind and bio energy		
M3.01	<p>Identify the Wind Energy and its uses</p> <p>Define power in wind, available wind power formulation, Power coefficient, Maximum Power.</p> <p>Identify the basic principle of wind energy conversion.</p> <p>List the main considerations in selecting a site for wind mills.</p> <p>List the advantages and limitations of wind energy conversion.</p> <p>Classify the wind mills.</p> <p>Explain the Construction and working of horizontal and vertical axis wind mills.</p>	8	Understanding
M3.02	<p>Describe the Energy from Biomass.</p> <p>List the Common species recommended for biomass.</p> <p>Identify the methods for obtaining energy from biomass. Define Pyrolysis, Gasification, and Hydrogenation. List the applications of gasifier.</p> <p>Explain the bio diesel production and its applications.</p> <p>Illustrate agriculture waste as a biomass.</p> <p>Explain the biomass digester.</p> <p>Compare biomass with conventional fuels.</p>	7	Understanding

Contents:

Wind Energy - uses

Wind power - wind power formulation - power coefficient - maximum power - principle of wind energy conversion - considerations in selecting a site for wind mills - advantages - limitations - classification

Horizontal wind mills - vertical axis wind mills - construction - working. Power generation - wind farm.

Energy from Biomass. Common species recommended for biomass - methods - pyrolysis - gasification - hydrogenation. Applications of gasifier - Bio diesel production - applications - agriculture waste as a biomass - biomass digester.

CO4	Explain different available non-conventional energy sources.		
M4.01	Identify the use of Geothermal Energy Explain the Geothermal Energy- Dry rock system, Wet rock system. Explain the Geo thermal Power plant and its function. List the principal parts and limitations.	5	Understanding
M4.02	Identify the Applications of MHD System. Explain Magneto Hydro Dynamic power generation. State it's Principle. List their limitations and applications.	5	Understanding
M4.03	Explain the working of Fuel Cells - H ₂ - O ₂ fuel cell. List the advantages, limitations and applications.	4	Understanding
	Series Test- II	1	

Contents:

Geothermal Energy

Geothermal energy - dry rock - wet rock - geo thermal power plant - function - principal parts - Limitations. Understand the applications of MHD system - magneto hydro dynamic -principle - common gases -

MHD power plant - components - limitations - applications

Fuel Cells - H₂- O₂ fuel cell

Advantages - limitations - applications

Text /Reference:

T/R	Book Title/Author
T1	Non-conventional Energy resources by Dr.B.H.Khan(Tata McGraw Hill)
T2	Energy Resource Management –KrupalSing Jogi (Sarup& sons)
R1	Non-conventional Energy sources - G.D.Rai (Khanna Publication)
R2	Solar Energy - S.P.Sukhatme (Tata McGraw Hill)
R3	Power Plant Engineering - Arrora, Domkundwar (Dhanpat Rai & Co.)
R4	Fundamental of Renewable Energy Sources, GN Tiwari and MK Ghoshal, Narosa, New Delhi,
R5	Renewable Energy and Environment-A Policy Analysis for India, NH Ravindranath, UK Rao, B
R6	Energy and The Environment, RA Ristinen and J JKraushaar, second edition, John Willey & Sons, New York, 2006.

Online Resources:

Sl.No	Website Link
1	https://en.reset.org/
2	https://nptel.ac.in/courses/121/106/121106014/
3	https://www.irena.org/
4	https://www.youtube.com/watch?v=RyzJlsxzG4A