SEMESTER 8

NON-CONVENTIONAL ENERGY SYSTEMS

Course Code	OECHT837	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand the importance and role of non-conventional energy systems in sustainable development.
2. To study various non-conventional energy sources and their technologies.

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	**Introduction to Non-Conventional Energy Systems:** Classification of Energy sources, Definition and importance of Non-Conventional Energy ,Global and national energy scenario, Environmental impacts of conventional energy sources, Need for non-conventional energy sources. India's non-conventional sources. Solar Energy: Solar Radiation, Measurement and estimation techniques, Solar Thermal Systems: Flat plate collectors, Concentrating collectors: Parabolic trough, dish, and solar tower. Applications: Solar water heaters, solar dryers, solar ponds. Solar Photovoltaic Systems: PV cell principles and materials (silicon, thin-film, organic), PV modules and arrays, solar farms, off-grid systems. Solar Power Plants.	10

2	**Geothermal Energy:** Energy Conversion Systems,energy extraction principles: Hot water and dry steam systems. **Wind Energy:** Wind Characteristics and Measurement, Wind Energy Conversion Systems, horizontal and vertical axis windmills, performance characteristics, Wind Power Generation.	**8**
3	**Ocean Energy:** Ocean Energy Resources: Tidal energy, Wave energy, Ocean thermal energy. Tidal Energy Conversion Systems: Tidal barrages and tidal stream systems, Wave Energy Conversion Systems: Oscillating water columns, point absorbers, and overtopping devices, operation. Ocean Thermal Energy Conversion (OTEC): Working principles and types (closed-cycle, open-cycle, hybrid). **Energy from biomass:** : Principles of Bio-Conversion, Anaerobic /aerobic digestion, pyrolysis, gasification, anaerobic digestion (biogas production), Biodiesels : Manufacture and characteristics.	**9**
4	**Hydrogen Energy:** Hydrogen Production Methods: Electrolysis, Thermochemical processes. Storage and Transportation: Compressed gas, liquid hydrogen, metal hydrides. Safety and infrastructure. **Fuel Cells**: Working principle, types, Characterization and durability of fuel cells, Applications.	**9**

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Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

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Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Classify various forms of Non-renewable and renewable energy and their importance.	**K2**
CO2	Explain solar energy and their technologies.	**K2**
CO3	Summarize Wind and Geothermal energy technologies	**K2**
CO4	Explain Ocean and Biomass energy technologies.	**K2**
CO5	Explain the principle of Hydrogen and Fuel cell technology.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					3	3					
CO2	3					3	3					
CO3	3					3	3					
CO4	3					3	3					
CO5	3					3	3					

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Energy for a Sustainable World	Goldmberg J., Johansson, Reddy A.K.N. & Williams R.H.	John Wiley	
2	Renewable Energy Sources & Conversion Tech	Bansal N.K., Kleeman M. & Meliss M	Tata McGraw Hill	
3	Non-Conventional Energy Systems	Mittal K.M	Wheeler Pub	
4	Non-Conventional Energy Sources	Rai G.D	Khanna Pub.	

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Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Chemical Technology	Venkataswarlu D	S. Chand	
2	Energy Technology	Rao S. & Parulekar B.B.	Khanna Pub.	
3	Solar Energy	Sukhatme S.P	Tata McGraw Hill	4th edition 2017

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1,2,3,4	https://onlinecourses.nptel.ac.in/noc22_ge14

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