PHY4011: Renewable Energy Science and Technology

Programme: B.Tech. (ECE) Year 4th year Semester: 8th Semester
Course : Other Elective Credits : 4 Hours : 40 hours

Course Context and Overview (100 words):

Energy crisis and global warming due to heavy dependence on fossil fuels are some of the major concerns of this decade. This course is designed to give an overview of energy science and technology with a major emphasis on renewable energy sources and related technologies. Students will learn the basic concepts related to the energy science and get an overview of non-renewable and renewable energy sources of nature, its conversion, transmission and storage.

Prerequisites Courses:

(None)

Course outcomes (COs):

On completion of this course, the students will:
▪ **CO1:** Get an overview of global energy scenario
▪ **CO2:** Have the basic understanding of the concepts of energy science
▪ **CO3**: Have a good understanding of conversion, transmission and storage of energy
▪ **CO4:** Get an overview of non-renewable energy technologies
▪ **CO5:** Get an overview of renewable energy technologies
• **CO6:** Get practical idea of calculation of solar energy of a particular location for the installation of solar energy collectors

Course Topics:

Topics	Lecture	Hours
UNIT - I **Energy Science**		
1. Introduction to Energy, History of Energy, Global Energy Scenario, Share of Energy, Utilization of Energy, Conventional and Renewable Energy Sources.	3	3

2. Concepts of Energy Conversion Processes: General Principles, 2nd Law of Thermodynamics, Concept of Entropy and Exergy, Quality of Energy, Thermodynamic Engine Cycles, Conversion processes of Heat Energy. Concepts of Energy transmission and Storage	7	7
UNIT - II **Conventional Energy Technologies**		
3. Thermal power Generation, Nuclear Power Generation, Hydro-electric power Generation	5	5
UNIT – III **Renewable Energy Technologies**		
4. Geothermal Power Generation: Types of Geothermal Resource, Direct use, Geothermal heat pump, Electricity, steam turbine technology, binary power plant technology	3	3
5. Concepts of solar energy: Solar spectrum, Air-mass, The sun-earth movement, angle of sun rays on solar panel/collector, sun tracking	3	3
6. Solar Thermal Energy Conversion: Active Solar Heating Technology, solar heating for industrial processes, passive solar heating and cooling,	2	2
7. Concentrating Solar Thermal Power: Solar concentration and CSP system, solar concentrator beam quality, solar concentration ratio: principles and limitation of CSP system, different type of solar concentrating power plants	3	3
8. Photovoltaics: Fundamentals, Technology and Applications	5	5
9. Wind Power: Wind resource, wind turbine, wind turbine aerodynamics, wind turbine loads, wind power structural dynamic consideration, peak power limitation, turbine subsystems, other wind energy conversion.	3	3
10. Small, micro Hydroelectric Power Plant & Tidal Power plant	1	1
11. Hydrogen Energy Technology: Properties of hydrogen, hydrogen production methods, hydrogen storage, liquid hydrogen, hydrogen transport and distribution, hydrogen conversion technology, hydrogen safety Fuel Cells: Principles & operation of fuel cells, typical fuel cell configuration, performance of fuel cells, fuel cell electrode processes, cells connection and stack design consideration	3	3
12. Biomass Energy: The basic concept of Biomass Energy, Application of Biomass Energy	1	1

Reference / Text books:

1. 'Introduction to Renewable Energy' by Vaughn Nelson
2. 'Renewable Energy Engineering and Technology Principles and Practice' by V. V. N Kishore
3. 'Solar Photovoltaics : Fundamentals, Technologies and Applications' C. S. Solanki
4. 'Handbook of Energy efficiency and Renewable Energy' by Frank Creith
5. Solar Energy: Principles of Thermal Collection and Storage by S. P. Sukhatme and J. K. Nayak
6. Non-Conventional Energy Resources by B H Khan

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

1. **Renewable Energy: Science & Technology by Prof. S. Banerjee (IIT-Kharagpur) [Important lectures --- 1, 2, 8-13, 15-25, 30-35 , 37 & 40] https://www.youtube.com/watch?v=BBQ2o0LcmnQ&list=PLB8D62518BDBD6B9C**
2. **Solar photovoltaics-- https://pveducation.org/**
3. **Introduction to renewable energy: https://www.youtube.com/watch?v=RM9xPXrnR8Y**
4. **Basic Thermodynamics https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8**

Evaluation Methods:

Item	Weightage
Monthly Assignment	20%
Final Examination	50%
Presentation after the final examination	30%

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