

COURSE TITLE	SUSTAINABLE ENERGY
COURSE CODE	01EE1505
COURSE CREDITS	3

Objective:

- 1 The course introduces the various sustainable energy sources including solar, wind and hydro energy as a potential source of energy for present and future need.

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

- 1 Explain the principle of energy conversion for various renewable energy sources.
- 2 Analyse the environmental aspects of various energy resources.
- 3 Classify various types of renewable energy sources.
- 4 Differentiate between the key components and configurations of photovoltaic systems and wind turbine systems.
- 5 Articulate various challenges associated with use of renewable energy sources.

Pre-requisite of course: Basic Electrical Engineering, Physics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	0	50	30	20	0	0

Contents : Unit	Topics	Contact Hours
1	Sustainable energy and energy Scenario Introduction; sustainability principle, classification of energy resources, factors affecting energy resource development, environmental aspects of energy, advantages and limitations of renewable energy, energy strategy for the future, energy scenario in India.	5
2	Solar Energy Introduction, radiation spectrum from sun and earth, irradiance, extra-terrestrial and terrestrial radiation, solar constant, basic sun-earth angles, diffuse radiation, beam radiation, measurement of solar radiation, pyranometer, pyrhelimeter, sunshine recorder, solar thermal energy, application of solar thermal energy, solar water heater, solar thermal power generation, solar pond.	10

Contents : Unit	Topics	Contact Hours
3	Solar Photovoltaic System Introduction, solar cell fundamentals, photovoltaic effect, solar cell, module, panel and array, solar cell characteristics and equivalent circuit, efficiency of solar cell, effect of variation of insolation and temperature, solar cell classification and types of solar cell, series and parallel arrays, maximising the solar PV output and load matching, solar PV system: standalone, grid connected & hybrid, application of solar PV systems	10
4	Wind Energy Introduction, global wind, wind turbine aerodynamics, energy available in wind, terms and definition of fluid dynamics, principle of power generation, axial thrust on wind turbine, torque generated by wind turbine, Types of wind mill: horizontal axis wind turbine, rotor of horizontal axis wind turbine, vertical axis wind turbine, rotor of vertical axis wind turbine, savonius rotor, darrieus rotor, wind turbine operation and power versus wind speed characteristics, wind energy conversion systems (WECS), types of generator used with wind turbine, environmental impact of wind turbine	11
5	Hydro Energy` Introduction, Schematic arrangement and main parts of hydro power plant, types of turbines, classification of hydro power plant, advantages and disadvantages, site selection of hydro power plant, Environmental aspects for selecting the sites and locations of hydro power stations	6
Total Hours		42

Textbook :

- 1 Non-Conventional Energy Resources, G.S. Sawhney, Prentice Hall of India, 2012
- 2 Non-Conventional Energy Resources, Shobh Nath Singh, Pearson Education India, 2016
- 3 Non-Conventional Energy Resources, B. H. Khan, McGraw Hill Education India (P) Ltd., 2017

References:

- 1 Renewable Energy Resources, Renewable Energy Resources, John Twidell and Tony Weir, Routledge, 2015
- 2 Sustainable Energy: Choosing Among Options, Sustainable Energy: Choosing Among Options, Tester, J. W., Drake, E. M., Driscoll, M. J., Golay, M. W., & Peters, W. A., The MIT Press, 2012
- 3 Renewable and Efficient Electric Power Systems, Renewable and Efficient Electric Power Systems, Gilbert M. Masters, John Wiley & Sons, 2004
- 4 Alternative Energy Systems and Applications, Alternative Energy Systems and Applications, B. K. Hodge, Wiley, 2017
- 5 Renewable Energy Technologies, Renewable Energy Technologies, J. C. Sabonnadiere, John Wiley & Sons, 2009

References:

- 6 Renewable Energy Sources, Renewable Energy Sources, John Twidell, Anthony D. Weir, Taylor & Francis, 2006

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
20.00	30.00	25.00	15.00	10.00	0.00

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, case studies etc.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the classroom.
- 3 Students will use supplementary resources such as online videos.

Supplementary Resources:

- 1 <https://www.coursera.org/learn/solar-energy-basics>
- 2 <https://www.coursera.org/learn/wind-energy>
- 3 <https://www.coursera.org/learn/solar-energy-system-design>
- 4 <https://www.coursera.org/learn/future-of-energy>
- 5 <https://www.coursera.org/learn/sustainable-development>
- 6 <https://www.edx.org/micromasters/uqx-sustainable-energy>
- 7 <https://www.edx.org/micromasters/delftx-solar-energy-engineering>
- 8 <https://www.edx.org/professional-certificate/imperialx-clean-power>
- 9 <https://www.edx.org/professional-certificate/delftx-buildings-as-sustainable-energy-systems>
- 10 <https://www.edx.org/course/solar-energy-integration-of-photovoltaic-systems-i>
- 11 <https://solarenergytraining.org/>