

**RENEWABLE ENERGY SOURCES**  
(OPEN ELECTIVE - II, Offered by EEE Dept.)

Pre requisites: NIL

**Course Objectives:**

1. Various renewable energy resources available at a location and assessments of its potential, using tools and techniques.
2. Solar energy radiation, its interactions, measurement and estimation
3. Site selection for wind turbines, wind systems, measurements and instrument
4. Geothermal, wave, tidal and OTEC resources, site selection

**UNIT-I (~6 Lecture Hours)**

**INTRODUCTION TO RENEWABLE ENERGY SOURCES:** Definition, Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES, Classification of NCES, Solar, Wind, Geothermal, Biomass, Ocean energy sources, Comparison of these energy sources.

**SOLAR ENERGY:**

Solar radiation spectrum - Extraterrestrial and terrestrial solar radiationsolar constant - Radiation measurement - Instruments for measuring solar radiation and Sun shine, solar radiation data.

**UNIT-II (~10 Lecture Hours)**

**SOLAR ENERGY COLLECTION, STORAGE AND APPLICATIONS:** Energy Collection: Flat plate and Concentrating collectors, their performance analysis and Classification of Concentrating collectors,

Energy Storage: Sensible heat, Latent heat, Stratified storage - Solar ponds.

Applications: Heating techniques, Cooling techniques, Solar Distillation and Drying,

**Solar Photovoltaic Generation**

PV Generation, Photovoltaic energy conversion - Operating principle, Photovoltaic cell concepts, Cell, module, array, Series and parallel connections, Potential of India in Solar energy utilization.

**UNIT-III (~10 Lecture Hours)**

**WIND ENERGY AND BIOMASS:** Wind energy: Power in Wind, Betz criteria,

Site selection, Types of wind mills, Characteristics of wind generators, Potential of India in

Wind Energy utilization.

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- 13) P. Reddy
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- 16) R. Balasubraman

**Bio-mass:** Principles of Bio-Conversion, Anaerobic, Aerobic digestion, Types of Bio-gas digesters, Pyrolysis, Applications - Bio gas, Wood stoves, Bio diesel, Economic aspects.

**UNIT-IV (~8 Lecture Hours)**

**GEOTHERMAL ENERGY AND OCEAN ENERGY:** Geothermal energy:

Resources, Methods of harnessing the energy - Introduction to Thermo dynamic Cycles- Potential of India in Geothermal energy options.

**Ocean energy:** OTEC - Principle of utilization, setting up of OTEC plants,

Thermodynamic cycles involved in OTEC. Tidal and wave energy - Potential and conversion techniques, Mini-hydel power plants and their economics in India.

**UNIT-V ~ (8 Lecture Hours)**

**DIRECT ENERGY CONVERSION :** Direct Energy Conversion (DEC), Need for DEC, Types of

DEC - Fuel Cells, working of hydrogen fuel cell Magneto Hydro Dynamic Energy Conversion

(MHD), Thermo Electric and Thermo Ionic Conversion (elementary treatment only), Working

Principle, Advantages and Disadvantages. Combined cycle and Co-generation.

**TEXT BOOKS:**

1. G.D. Rai, "Non-Conventional Energy Sources", 5<sup>th</sup> Edition, Khanna Publishers, 2009.
2. D.P.Kothari, K.C.Singhal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", 2<sup>nd</sup> Edition, P.H.I., 2014.
3. Twidell & Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 3<sup>rd</sup> Edition, 2006.

**REFERENCE BOOKS:**

1. Tiwari, Ghosal, "Renewable Energy Resources", Narosa Publications , 2005
2. Sukhatme.S.P, Solar Energy: "Principles of Thermal Collection and Storage", 3<sup>rd</sup> Edition, Tata McGraw Hill, 2008.

**Course outcomes**

After completion of this course the students should able to

1. Estimate the solar energy, Utilization of solar energy, Principles involved in solar energy collection and conversion of it to electricity generation
2. Explore the concepts involved in wind energy conversion system by studying its components, types and performance
3. Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications
4. Acquire the knowledge on Geothermal energy and it's harnessing methods
5. Illustrate ocean energy and explain the operational methods of their utilization.
6. Describe the concept of direct energy conversion and their types and working principle

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