

**GREEN ENGINEERING SYSTEMS****Course Objective:**

The course aims to highlight the significance of alternative sources of energy, green energy systems and processes and provides the theory and working principles of probable sources of renewable and green energy systems that are environmental friendly.

**UNIT-I****INTRODUCTION:**

**SOLAR RADIATION:** Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – types of PV cells, I-V characteristics.

**SOLAR ENERGY COLLECTION:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

**UNIT – II**

**SOLAR ENERGY STORAGE AND APPLICATIONS:** Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

**WIND ENERGY:** Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

**UNIT – III**

**BIO-MASS:** Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

**GEOTHERMAL ENERGY:** Resources, types of wells, methods of harnessing the energy, potential in India.

**OCEAN ENERGY:** OTEC, Principles of utilization, setting of OTEC plants,

thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

#### **UNIT –IV**

##### **ENERGY EFFICIENT SYSTEMS:**

- (A) **ELECTRICAL SYSTEMS:** Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management.
- (B) **MECHANICAL SYSTEMS:** Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmental friendly and Energy efficient compressors and pumps.

#### **UNIT-V**

**ENERGY EFFICIENT PROCESSES:** Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmental friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.

#### **UNIT – VI**

**GREEN BUILDINGS:** Definition, features and benefits. Sustainable site selection and planning of buildings for maximum comfort. Environmental friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste, Ferro cement and Ferro-concrete, alternate roofing systems, paints to reduce heat gain of the buildings. Energy management.

##### **TEXT BOOKS:**

1. Sukhatme S.P. and J.K.Nayak, *Solar Energy – Principles of Thermal Collection and Storage*, TMH.
2. Khan B.H., *Non-Conventional Energy Resources*, Tata McGraw Hill, New Delhi, 2006.
3. *Green Manufacturing Processes and Systems*, Edited by J. Paulo Davim, Springer 2013.

##### **REFERENCES:**

1. *Alternative Building Materials and Technologies* / K.S Jagadeesh, B.V Venkata Rama Reddy and K.S Nanjunda Ra.

2. Principles of Solar Energy / Frank Krieth & John F Kreider.
3. Non-Conventional Energy / Ashok V Desai /Wiley Eastern.
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa
5. Renewable Energy Technologies/ G.D Roy

**Course outcome:**

The student shall understand the principles and working of solar, wind, biomass, geo thermal, ocean energies and green energy systems and appreciate their significance in view of their importance in the current scenario and their potential future applications.