

## EN661 Renewable Energy Systems (3-0-0-6)

**Energy Resources and their utilization:** Overview of Global and Indian energy scenario, Sources of Energy and its classifications, Renewable energy sources, classification and systems, Environmental aspects, Energy and Climate change

**Biomass Energy:** Biomass properties and type, Properties: proximate and ultimate analysis, calorific value, density, moisture content, Description of different types of biomass, Biomass conversion processes, Different conversion processes such as biochemical conversion, thermochemical conversion and mechanical extraction, Chemical equilibrium and reaction kinetics, Pre-treatment of biomass, Generation of heat and power, Stoichiometry, Power generation from biomass (IC engine, turbines and fuel cells), IGCC and case study, Economic analysis

**Wind Energy Conversion:** Classification and descriptions of wind turbine, Wind data, Energy in the wind, Wind energy extraction, Mean wind speed and energy estimation, Mathematical derivation of Betz limit, Performance calculation, Blade profiles, Wind resource assessment in India

**Solar Photovoltaic system:** Solar radiation and its measurement, Solar Thermal Energy Conversion, Semiconductor material and doping, Solar PV in India

**Small Hydropower:** Power equations, Classification of small hydropower stations,

Classification of water turbines, Major components of small hydropower projects

**Geothermal Energy:** Geothermal resources, Geothermal power generation, Global status of electricity generation from geothermal resources, Advantages of geothermal energy

**Ocean Energy:** Ocean thermal power generation, Global status of electricity generation, Advantages of ocean thermal energy

**Fuel Cells and Hydrogen Energy Systems:** Methods of hydrogen production, Range of applications for renewable hydrogen consumption, Hydrogen storage and safety issues, Operation of fuel-cell, components and characterization

**Hybrid Energy systems:** Need for hybrid systems, Types of hybrid systems, Electric and hybrid electric vehicle, Hydrogen power electric vehicle, IGCC, combined cycle

### Texts/References:

- [1]. Nag P.K., Thermodynamics (1996), **Tata McGraw Hill**
- [2]. Garg H. P. and Prakash S. (1997); *Solar Energy: Fundamental and Application*, **Tata McGraw Hill**
- [3]. Mohammad Omar Abdullah (2012); *Applied Energy: An Introduction*, **CRC Press**
- [4]. B H Khan (2014); Non-Conventional Energy Resources, 2<sup>nd</sup> Edition, **McGraw Hill Education**
- [5]. Solanki C. S. (2009); *Solar Photovoltaics: Fundamentals, Technologies and Applications*, Prentice Hall India
- [6]. Nag P.K., Power Plant Engineering (2002), **Tata McGraw Hill Education**