

*Module No. 1: Introduction to renewable energy resources
& technologies*

No. of weeks / credits 10

Week 1-2

- **The Solar Energy Resource**
 - Introduction
 - Spectral Distribution
 - Sun–earth Geometric Relationship
 - Sun's Trajectories in Different Seasons
 - Solar Terminologies
 - Radiations Calculations of Different Surfaces with Different Inclinations
 - Beam and Diffuse Components of Hourly and Daily Radiation
 - Measurement of Solar Radiation
 - Radiation Measurement Stations
 - Prediction of Available Solar Radiation
 - Methods Used for Estimating Solar Radiation
 - Solar Mapping Using Satellite Data

Week 3-4

- **Wind Energy Resources**
 - Overview of Wind Energy Developments
 - Wind Resource Assessment
 - Physics of Wind
 - Mechanics of Wind
 - Wind Power Density
 - Wind Measurements
 - Instrumentation and Data Characteristics
 - Instrumentation
 - Estimation of Weibull Parameters
 - Spatial Wind Resource Assessment Tools: GIS and Satellite Data

Week 5

- **Bio energy resources**
 - Bio Mass Resources
 - Characterisation of Biomass
 - Bulk Chemical Properties
 - Ultimate Proximate Analysis
 - Chemical Composition of Biomass
 - Structural Properties
 - Physical Properties
 - Properties of Microbial Biomass
 - Biomass Resource Assessment
 - Analysis of Wastes

Week 6

- **Small Hydro: Resource**
 - Introduction
 - Small Hydro Power Programme (SHP) in India
 - Small Hydro Resource Assessment

Week 7

- **Tidal Power**
 - Introduction
 - The Nature of the Resource
 - Basic Physics
 - Types of Tides
 - Tidal Energy Potential Across the World
 - Tidal Energy - Indian Program

Week 8

- **Solar Photovoltaic Technologies**
 - A brief history of PV
 - The PV effect in crystalline silicon: Basic Principles
 - Crystalline PV: reducing costs and raising efficiency
 - Thin film PV and other PV technologies
 - Electrical characteristics of silicon PV cells and modules
 - PV systems for remote power
 - Grid-connected PV systems
 - Costs of energy from PV
 - Environmental impact and safety
 - PV integration, resources and future prospects

Week 9

- **Bioenergy Technologies**
 - Bioenergy Past and Present
 - Biomass as a Solar Energy Store
 - Biomass as a Fuel
 - Primary Biomass Energy Sources: Plant Materials
 - Secondary Biomass Sources: wastes, residues and co-products
 - Physical processing of Biomass
 - Thermochemical Processing
 - Environmental Benefits and Impacts
 - Economics
 - Future prospects for Bioenergy

Week 10

- **Wind Energy Technologies**

- Introduction
- Wind Turbines
- Aerodynamics of Wind Turbines
- Power and energy from Wind Turbines
- Environmental Impact
- Economics
- Commercial Development and Wind Energy Potential
- Offshore Wind Energy