

Renewable Energy Systems

Unit I	Introduction to energy resources and Hydroelectricity Basic Forms of Energy - Energy, Work, and Power - Capacity Factor and Efficiency - Energy resources - Conventional sources of energy - non-conventional sources of energy - Comparison of various energy sources - Barriers to the use of Renewable energy technologies - commercializing barrier- market barriers Hydroelectricity-Elements of a Hydroelectric Power Plant-Classifications of Hydroelectric Plants by Effective Head of Water-Advantages and Disadvantages of Hydropower
Unit II	Solar and Biomass energy Extra-terrestrial solar radiation and its spectral distribution – Solar water heaters – Solar thermal power plants and types Photovoltaic (PV) or solar Cell - Functions of a PV cell - PV modules and arrays - Benefits and limitations of photovoltaic systems Primary and Secondary Biomass Energy Sources -Biofuel production processes and classification- Advantages and disadvantages of biomass
Unit III	Wind, Tidal and Geothermal energy Power in the wind- Horizontal-axis Wind Turbines and Vertical Axis Wind Turbines - advantages and disadvantages Tidal phenomenon and principle of tidal power generation systems -Diurnal, Semidiurnal and mixed tides - Advantages and disadvantages Origin of geothermal energy and classes of global geothermal regions-Types of geothermal plants (dry and flashed steam power plants)-applications
Unit IV	Energy storage devices The Need to Store Energy - Electromechanical Storage [Pumped Storage, Flywheels, Torsion Bars] - Thermal Storage [Phase-Change Materials] - Chemical Storage [Lead acid batteries, and Lithium batteries, Fuel Cells and Supercapacitor] Hydrogen Storage-advantages and limitations
Unit V	Environmental effects and Sustainability Environmental Impacts of Hydropower, Solar Energy, Biomass, Wind Energy, and Geothermal Energy Greenhouse Gas Emissions - Effects on Climate - Mitigating and Remedial Actions Finite Life of a Resource - Sustainable Energy Supply and Limitations

Prescribed Books

1. Renewable Energy Technologies and Resources by Nader Anani
2. Textbook of Renewable Energy by S. C. Bhatia and R. K. Gupta
3. Energy, the environment, and sustainability by Efstathios E. Michaelides, CRC Press, 2018
4. Renewable Energy Resources by John.W.Twidell, Anthony.D.Weir, (1987) English language book society/E.&F.N.Spon.
5. Robert Ehrlich-Renewable Energy, Second Edition_ A First Course

References

1. Understanding renewable energy systems by Volker Quaschnig, Earthscan, London
2. Electrochemical Energy Storage for Renewable Sources and Grid Balancing, Patrick T. Moseley, Juergen Garche, Elsevier

Suggested Reading

1. Introduction To Energy Essentials - Insight into Nuclear, Renewable, and Non-Renewable Energies, Academic Press
2. The Physics of Renewable Energy, Martin Stutzmann, Christoph Csoklich, Springer

Web Resources

1. <https://www.sciencedirect.com/topics/engineering/renewable-energy-source>
2. <https://education.nationalgeographic.org/resource/renewable-energy-explained/>
3. <https://www.nationalgrid.com/stories/energy-explained/what-is-battery-storage>