

RENEWABLE ENERGY SYSTEMS

Module I

[15 Hours]

University Portion (80%): (13 Hours)

Introduction: Conventional energy Sources and its Impacts, Non conventional energy-seasonal variations and availability, Renewable energy – sources and features, Distributed energy systems and dispersed generation (DG) (Textbook-1, Chapter-1.10, 1.13, 1.14)

Solar Energy: Solar processes and spectral composition of solar radiation. Solar Thermal system- Solar collectors, Types and performance characteristics, Applications- Solar water heating systems (active & passive) , Solar space heating & cooling systems , Solar desalination systems, Solar cooker. Solar photovoltaic system-Operating principle, Photovoltaic cell concepts, Cell, module, array, Losses in Solar Cell, Effects of Shadowing- Partial and Complete Shadowing, Series and parallel connections, Cell mismatching, Maximum power point tracking, Applications-Battery charging, Pumping, Lighting, Peltier cooling. Modeling of PV cell. (Textbook-1, Chapter- 4.1, 4.2, 4.5, 4.10, 4.11, 5, 6)

College/Institute Portion (20%):(2 Hours)

Classification of energy Sources, Extra-terrestrial and terrestrial Radiation, Azimuth angle, Zenith angle, Hour angle, Irradiance, Solar constant Or related advanced topics as decided by the concerned faculty teaching the subject.

Module II

[10 Hours]

University Portion (80%): (8 Hours)

Wind Energy: Wind energy, Wind energy conversion; Wind power density, efficiency limit for wind energy conversion, types of converters, aerodynamics of wind rotors, power ~ speed and torque ~ speed characteristics of wind turbines, wind turbine control systems; conversion to electrical power: induction and synchronous generators, grid connected and self excited induction generator operation, constant voltage and constant frequency generation with power electronic control, single and double output systems, reactive power compensation, Characteristics of wind power plant, Concept of DFIG. (Textbook-2, Chapter-1.2, 1.4, 1.5, 1.6, 1.7, 1.8, 1.10, 1.11, 1.12, 3, 5)

College/Institute Portion (20%):(2 Hours)

Velocity at different heights, Basics of Fluid Mechanics (Textbook-1, Chapter-7.1, 7.2, 7.5) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module III

[9 Hours]

University Portion (80%):(9 Hours)

Biomass Power: Principles of biomass conversion, Combustion and fermentation, Anaerobic digestion, Types of biogas digester, Wood gassifier, Pyrolysis, Applications. Bio gas, Wood stoves, Bio diesel, Combustion engine, Application. (Textbook-1, Chapter-8)

College/Institute Portion (20%): (2 Hours)

Urban Waste to Energy Conversion, Fuel cell. (Textbook-1, Chapter-8.6) Or related advanced topics as decided by the concerned faculty teaching the subject.

Module IV

[6 Hours]

University Portion (80%): (4 Hours)

Hybrid Systems: Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles.

(Textbook-2, Chapter-7)

College/Institute Portion (20%):(2 Hours)

Small hydro Resources, Magnetohydrodynamics power conversion (Textbook-1, Chapter-11.4,12.2) Or related advanced topics as decided by the concerned faculty teaching the subject.

Text Books:

1. *Renewable Energy- Power for a Sustainable Future*, Godfrey Boyle, Oxford University Press
2. *B.H.Khan, Non-Conventional Energy Resources*, Tata McGrawHill, 2009
3. *S. N. Bhadra, D. Kastha, S. Banerjee, Wind Electrical Systems*, Oxford Univ. Press, New Delhi, 2005.

Reference Books:

1. *S. A. Abbasi, N. Abbasi, Renewable Energy Sources and Their Environmental Impact*, Prentice Hall of India, New Delhi, 2006