GUJARAT TECHNOLOGICAL UNIVERSITY

Mechanical (Thermal Engineering)

M.E. Semester: IV

Subject Name: **Non-Conventional Energy Conversion Systems**

Sr. No.	Course Content
1.	**Solar Energy:** solar constant, spectral distribution of extraterrestrial radiation, beam and diffuse radiation, Attenuation of beam radiation, equinox and solstice, solar angle, solar time, equation of time, solar radiation measurements, pyranometers, pyrheliometers, estimation of average solar radiations. Flat plate collectors, its components, absorber plate, reflective surfaces, their properties, cover plates, choice of material of cover plates, basic flat plate energy balance equation and collector efficiency, thermal analysis of flat plate collectors and useful design considerations of flat plate collectors. Focusing on concentrating collectors, their advantages and disadvantages over flat plate collector general characteristics, thermal performance and design considerations of focusing collectors. Photo voltaic cells, principles and circuit, properties and load, limits of cell efficiency, design consideration and construction, types and adaptation of photovoltaic, advantages, disadvantages and applications of solar cells.
2.	**Biogas & Biomass Energy:** Biogas conversion technologies, biogas generation, factors affecting biogas generation, classification of biogas plants, advantages and disadvantages of floating drum plant, and fixed dome type plant, constructional details and design criteria of various biogas plants, selection of site, problems related to biogas plants, fuel properties of biogas, utilization of biogas, biogas development in India. Biomass as a source of energy, energy plantation, advantages, plants proposed for energy plantation, methods of obtaining energy from biomass, biomass gasification, classification of biomass gasifier, chemistry of gasification process, application, advantages and disadvantages of biological conversion of solar energy.
3.	**Wind Energy:** Brief history, wind data, wind measurement and measuring instruments, basic principles of wind energy conversion, power in the wind, maximum power, basic components of wind energy conversion systems (WECS), classification, advantages and disadvantages of different WECS, design consideration of horizontal axis and vertical axis machines, analysis of aerodynamics forces acting on blades, performance of wind machines, schemes for electrical power generation, site selecti/on consideration, energy storage, applications, maintenance, safety, environmental aspects, economic consideration of wind machines.

4.	**Direct Energy Conversion Systems:** Fuel cells, principle of operation and design consideration of fuel cells, their classification advantages, disadvantages, work output and EMF of fuel cells, applications of fuel cells. Magneto-hydrodynamic power generation - Principle of MHD power generation, MHD systems, their design problems, advantages and disadvantages, problems associated with MHD, plant configurations, detailed analysis of MHD generation. Thermoelectric power, basic principles, thermoelectric power generator, performance analysis thermoelectric materials and their selection. Thermionic generation, thermionic emission and work function, basic thermionic generator and its analysis. Recent trends in direct energy conversion systems.
5.	**Hydrogen Energy:** Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles.

References Books:

1. Non-conventional energy sources by G.D. Rai, Khanna Publishers.
2. Solar Energy: Fundamentals and Applications by H. P. Garg & Jai Prakash, TMH.
3. Solar Energy: Principles of Thermal Collection and Storage by S. P. Sukhatme, TMH.
4. Alternative Energy Sources by B. L. Singhal, Tech Max Publication.
5. Non Conventional Energy Resources by S.Hasan Saeed and D. K. Sharma.
6. Fuel Cells by Bockris and Srinivasan; McGraw Hill.
7. Magneto Hydrodynamics by Kuliovsky and Lyubimov, Addison Publication.
8. Solar Engineering of Thermal Processes by Duffic and Beckman, John Wiley.