

SYLLABUS FOR RENEWABLE ENERGY

1. *Energy Resources and Utilization*

Conventional and non-conventional energy resources and their potential, Introduction of Conventional fuels (Coal, oil, natural gas), Fuels (solid, liquid, gas): characterization (ultimate, Proximate analysis, etc.), gasification, combustion, utilization of conventional fuels in combustion engines (Steam, Gas turbines, IC engines) and fuel cell, related challenges, and environmental effects.

Nuclear energy: fuel resources, nuclear reactor, and their environmental impact; Renewable energy

2. *Non-Conventional Source of Energy*

Global & National energy scenarios, Forms & characteristics of renewable energy sources, Solar radiation, Flat plate collectors, Solar concentrators, Thermal Applications of solar energy, Photovoltaics technology and applications, Energy storage, Energy from biomass, Thermochemical, Biochemical conversion to fuels, biogas and its applications, Wind characteristics, Resource assessment, Horizontal & vertical axis wind turbines, Electricity generation and water pumping, Micro/Mini hydropower systems, Water pumping and conversion to electricity, Hydraulic ram pump, ocean Thermal Energy Conversion (oTEC), Geothermal, Tidal and Wave energies.

3. *Fundamentals of Energy Engineering*

Energy consumption pattern in different sectors (Industries, commercial and residential buildings, agriculture, service industries, etc.). Fundamental and applied concepts of energy for strengthening of sustainable energy and environment, thermal and electrical utilities, energy flow and Sankey diagram, measures of energy efficiency improvements, demand and supply analysis, life cycle assessment, and emerging issues in the built environment.

4. *Energy Conservation and Management*

Importance of energy management. Energy auditing: methodology, analysis of past trends (plant data), closing the energy balance, laws of thermodynamics.

Steam Systems: Boiler -efficiency testing, excess air control, Steam distribution & use- steam traps, condensate recovery, flash steam utilisation. Thermal Insulation.

Electrical Systems: Demand control, power factor correction, load scheduling/shifting, Motor drives- motor efficiency testing, energy efficient motors, motor speed control.

Lighting: lighting levels, efficient options, fixtures, daylighting, timers, Energy efficient windows.

Energy conservation in Pumps, Fans (flow control), Compressed Air Systems, Refrigeration & air conditioning systems. Waste heat recovery: recuperators, heat wheels, heat pipes, heat pumps.

Cogeneration: concept, options (steam/gas turbines/diesel engine based), selection criteria, control strategy. Heat exchanger composite curves.

Demand side management.

5. Energy Storage

Sensible Thermal Energy Storage, Latent Energy Storage, Thermal Management System design using Latent Thermal Energy Storage, optimization of Thermal Energy Systems, Thermochemical heat storage system, Battery Electrical Energy Storage Systems, Pumped storage systems, other electrical energy storage systems, Integration of energy storage systems, energy storage system optimization
Hydrogen Economy

Rechargeable batteries and their Fundamental electrochemistry, Lithium batteries, Nickel metal hydride battery, Lead-acid battery, High temperature batteries for back-up applications, Flow batteries for load levelling and large scale grid application, Ni-Hydrogen batteries for space and marine applications, Manufacturing technologies of batteries, Sustainable design of batteries, Hybridization of battery, Battery recycling technologies, Battery applications for stationary and secondary use, Battery chargers and battery testing procedures, Battery management, Regulations and safety aspects of high voltage batteries, Super capacitors.

6. Energy, Ecology & Environment

Concepts of ecosystems and environment, Characteristics and types of ecosystems, Autecology and synecology, Energy flow in ecosystems, Feedback loops, Trophic webs, Eco-technology and Eco-development, Energy-environment interaction, Impact of energy sources (coal, oil, natural gas, solar, wind, biomass, hydro, geothermal, tidal, wave, ocean thermal and nuclear) on environment, local regional and global implications, Approaches to mitigate environmental emissions from energy sector, Global initiatives Kyoto Protocol, Clean development mechanism, Case studies.

7. Environmental Regulations

Environmental legislation and strategies to control pollution, Standards and setting criterion, Role of national and international agencies in dealing with environmental aspects. Standards developed by ministry of environment and forest, Sampling and analysis techniques, Data interpretations and relationships for the design of treatment facilities. Regulations for pollution controls of water, air industrial, automobile, Noise and hazardous waste environmental audit, Public liability insurance, Environment management systems, Catalytic converters in vehicles in metropolitans, Euro standards, Bharat standards.