RENEWABLE ENERGY RESOURCES
(Elective-II)

Course Code: 13ME2313

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Course Outcomes:

At the end of the course, the student will be able to

CO1 : Explain solar energy radiation, analyze different solar collectors, energy conversion systems.

CO2 : Discuss power generation using geothermal and wind energy.

CO3 : Describe power generation in biomass and bio-fuels.

CO4 : Analyze the electro chemical effects and fuel cells, hydrogen energy cycle.

CO5 : Apply the direct energy conversion methods, wave and tidal energy.

UNIT – I

Introduction – Renewable Energy sources-energy parameters-cogeneration-new technologies-distributed energy systems-impact of renewable energy generation on environment-solar energy, wind energy, biomass energy, geothermal energy, ocean energy.

Scenario - survey of energy resources – classification – need for non-conventional energy resources.

Solar Radiation and its Measurement**:** The Sun – sun-earth relationship – solar radiation – radiation measuring instruments.

Solar Collectors: Solar collectors- flat plate collector- performance analysis of flat plate collector- solar air collectors-solar concentrating collectors- performance analysis -types of concentrating collectors-compound parabolic concentrator (CPC)-Tracking CPC and solar swing - performance analysis.

Solar Thermal Energy Storage: Different systems.

Solar Thermal Energy Conversation Systems**:** solar water heating– heating of swimming pool-solar thermal power plant-central receiver power plants– solar ponds-solar pumping systems-solar air heaters- solar crop drying –solar kilns-integrated solar dryers- solar cooker-solar passive techniques-solar air conditioning & refrigeration-solar green houses.

Solar Photovoltaic System: Semi conductor materials and doping-p-n junction-photovoltaic effect- efficiency of solar cells- semiconductor materials for solar cells- solar photovoltaic system (SPS)-application-plastic solar cells with nanotechnology.

UNIT – II

Geothermal Energy: Introduction-structure of earth – plate tectonic theory-geothermal field–geothermal gradients- geothermal power generation-preheat hybrid with conventional plant- resources in India.

Wind Energy: Introduction- classification of wind turbines-types of rotors-terms used-aerodynamic operation –wind energy extraction-extraction of power-wind characteristics-mean wind speed & energy estimation-power density duration curve- types of wind machines-modes of wind power generation.

UNIT - III

Bio – Energy: Introduction-biomass resources-bio fuels-biogas-producer gas-biomass conversion technologies-biochemical conversion-biomass gasification-biogas technology-biogas plants-energy recovery from urban waste-MSW based power project-power generation from land fill gas- power generation from liquid waste-biomass cogeneration-ethanol from biomass-bio diesel-bio fuel petrol-biomass resource development in India-environmental benefits.

UNIT – IV

Electro Chemical Effects and Fuel Cells: Principle of operation of an acidic fuel cell-technical parameter of fuel cell-fuel processor-methanol fuel cell-classification of fuel cells- other types of fuel cells- comparison between acidic and alkaline hydrogen oxygen fuel cells- efficiency and EMF of fuel cells- operating characteristics of fuel cells- advantages of fuel cell power plants- future potential of fuel cells.

Hydrogen Energy: Properties of hydrogen in respect of its use as source of renewable energy- sources of hydrogen- production of hydrogen-storage and transportation- safety and management-development of hydrogen cell- economics of hydrogen fuel and – I.C. Engines applications – utilization strategy – performances.

UNIT – V

Energy from Oceans: Tidal Energy: Introduction to -tidal characteristics-range-energy estimation for tidal power project-double cycle system-development of tidal power scheme-components of power plant-advantages and disadvantages-global scenario-power development in India.

Wave Energy: Introduction -factors effecting wave energy-ocean wave parameters-energy from waves-wave power data-energy resource in India-wave area-analysis of wave energy-wave energy conversation-principles of wave energy-wave power development in India-OTEC.

Direct Energy Conversion: Need for DEC- Carnot cycle- limitations-Principles of DEC. Thermo-electric generators-Seebeck-Peltier and Joule-Thompson effects- figure of merit- materials- applications-MHD generators- principles- dissociation and ionization- Hall effect-magnetic flux- MHD accelerator- MHD engine- power generation systems-electron gas dynamic conversion- economic aspects.

TEXT BOOKS:

1. D.P. Kothari, K.C. Singal, Rakesh Ranjan, "*Renewable Energy Resources and Emerging Technologies"*, 2nd Ed., PHI Learning Private Limited , 2012 .
2. G.D. Rai., "*Non-conventional Energy sources"*, 4th Edition, Khanna Publishers, 2008.

REFERENCES:

1. Suhas- P. Sukhatma and Nayak- J.K., "*Solar Energy"*, 3rd Ed., TMH- New Delhi, 2008.
2. G.N.Tiwari and M.K.Ghosal, "*Fundamentals of Renewable Energy Resources"*, Alpha Science International Limited, 2007.
3. John Twidell & Tony Weir, "*Renewable Energy Resources"*, 2nd Edition, Taylor & Francis, 2006.