RENEWABLE ENERGY RESOURCES
(Elective-II)

Course Code: 13ME2313

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Pre requisites: basic heat transfer

Course Educational Objectives:

To make the student

1. introduce to the technology of renewable sources of energy
2. learn about the solar radiation, its applications and radiation measuring instruments
3. learn about the various types of geothermal resources and its applications
4. study the biomass energy resources , bio-mass systems
5. learn the methods of energy extraction from the wind and oceans
6. learn to the technology of direct energy conversion methods

Course Outcomes:

Student will be able to

1. take up small scale projects- as entrepreneurs- since the cost of investment is minimal in some of the sources.
2. apply the technology to capture the energy from the renewable sources like Sun, wind, ocean, biomass, geothermal
3. apply the direct energy conversion methods

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.