RENEWABLE SOURCES OF ENERGY

(PROFESSIONAL ELECTIVE-VI)

Course Code: 15ME1151	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course outcomes:

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

CO1: Explain solar energy radiation, solar collectors and energy conversion systems.

CO2: Discuss power generation using geothermal and wind energy.

CO3: Describe power generation using biomass and bio-gas.

CO4: Explain electro chemical effects, hydrogen energy and fuel cells.

CO5: Outline direct energy conversion methods and principles of ocean and tidal energy.

UNIT-I **(12 Lectures)**

INTRODUCTION: Conventional & non-conventional energy sources-prospects of renewable energy sources.

SOLAR ENERGY: Extra-terrestrial radiation-spectral distribution-solar constant-solar radiations on earth-measurement of solar radiations-solar radiation geometry-expression for angle between incident beam and the normal to a plane surface(no derivation)-local apparent time-apparent motion of sun-day length-solar radiation data for India.

SOLAR COLLECTORS: - solar collectors- flat plate collectors-concentrating collectors- types -energy storage systems.

PHOTOVOLTAIC SYSTEM: photovoltaic effect-efficiency of solar cells- semiconductor materials for solar cells- solar photovoltaic system.

APPLICATIONS OF SOLAR ENERGY: Water heating-space heating & cooling-solar distillation-solar pumping- solar cooking- greenhouses.

UNIT-II **(10 Lectures)**

WIND ENERGY: Principles of wind energy conversion-availability of wind energy in India-wind velocity- components of wind energy conversion systems (WECS)-classification of WECS-Horizontal and Vertical axis wind mills -performance characteristics-Betz criteria coefficient–-applications of WECS-energy storage-environmental aspects-economic issues- recent developments.

GEOTHERMAL ENERGY: Structure of earth's interior-geothermal sites-earthquakes & volcanoes- geothermal resources -hot springs-steam ejection-principle of working-site selection for geothermal power plants-problems associated with geothermal conversion-applications-geothermal energy prospects in India.

UNIT-III **(8 Lectures)**

BIO-MASS & BIOGAS: Principles of biomass-conversion-photosynthesis-bio gas production-aerobic and anaerobic bio-conversion process-raw materials-properties of biogas-producer gas-transportation of biogas-classification of bio gas plants-advantages and disadvantages-types of bio gas plants-community bio gas plants-problems involved in biogas production-bio gas

applications-biomass conversion techniques-biomass gasification- energy recovery from urban waste-power generation from liquid waste-biomass resource development in India.

UNIT-IV **(10 Lectures)**

ELECTRO CHEMICAL EFFECTS AND FUEL CELLS: Principle of operation of an acidic fuel cell-classification and 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 its use.

UNIT-V **(10 Lectures)**

OCEAN ENERGY: Principle of ocean thermal energy conversion-wave energy conversion machines-power plants based on ocean energy-problems associated with ocean thermal energy conversion systems-thermo electric OTEC- developments of OTEC.

TIDAL POWER: Tides and waves as sources of energy-fundamentals and use of tidal energy-limitations of tidal energy conversion systems.

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 engines.

TEXT BOOK:

Rai G.D, "*Non-Conventional energy Sources*", Khanna Publishers, 4th editon, 2008.

REFERENCES:

1. Suhas. P.Sukhatma and Nayak.J.K., "*Solar Energy*", TMH, New Delhi, 3rd Edition,2008.
2. D.P.Kothari, Rakesh Ranjan and K.C. Singal., "*Renewable Energy Resources and Emerging Tech.*", Prentice Hall of India Pvt. Ltd., 2nd Edition, 2011.
3. Sawhney, G.S., "*Non-Conventional Energy Sources*", Prentice Hall Inc., Delhi, 2012.