# ALTERNATE SOURCES OF ENERGY

(Elective-II)

**Course Code: 15ME2318**

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**Course Outcomes:** At the end of the course, the student will be able to

**CO1:** Discuss power generation using geothermal energy.
**CO2:** Explain thermodynamic application in fuel cell
**CO3:** Explain electrochemistry in fuel cell
**CO4:** analyze various components, material properties and process
**CO5:** Discuss power generation using wind energy

**UNIT –I** (10-Lectures)

**Introduction:** Types of Fuel Cells-Working of fuel cell- Fuel Cell Applications

**Fuel Cell Basic Chemistry and Thermodynamics:** Reactions, Heat of Reaction- Higher and Lower Heating Value of Hydrogen, Theoretical Electrical Work , Theoretical Fuel Cell Potential, Effect of Temperature, Theoretical Fuel Cell Efficiency ,Carnot Efficiency Myth and Effect of Pressure

**UNIT-II** (10-Lectures)

**Fuel Cell Electrochemistry:** Electrode Kinetics, Reaction Constants, Transfer Coefficient, Exchange Current Density, Activation Polarization, Crossover Losses, Ohmic Losses, Concentration Polarization, Cell Potential—Polarization Curve

**UNIT-III** (10-Lectures)

**Main Cell Components, Materials Properties and Processes:** Cell Description- Membrane- Electrode- Gas Diffusion Layer- Bipolar Plates

**UNIT-IV** (10-Lectures)

**Geothermal Energy:** Structure of earth, Geothermal Regions, Hot springs. Hot Rocks, Hot Aquifers. Analytical methods to estimate thermal potential. Harnessing techniques, Electricity generating systems.

**UNIT-V** (10-Lectures)

**Wind Energy**: Wind, Beaufort number, Characteristics, Wind energy conversion systems, Types, Betz model. Interference factor. Power coefficient, Torque coefficient and Thrust coefficient, Lift machines and Drag machines. Matching, Electricity generation.

**TEXT BOOKS:**

1. Frano Barbir, "*PEM fuel cell- theory and practice*" 2nd edition, academic press (I, II & III Units).
2. G.N.Tiwari and M.K.Ghosal "*Renewable Energy Resources- Basic Principles and Applications*", Narosa Publications (IV&V Units).

**REFERENCES:**

1. John Twidell & Tony Weir "*Renewable Energy Resources*" 2nd edition, Taylor & Francis.
2. Rai G.D, "*Non-Conventional energy Sources*", Khanna Publishers, fourth edition, 2008.