Energy Resources and Utilization

1.1 Course Number: CH231
1.2 Contact Hours: 28 Credits: 2-0-2
1.3 Semester-offered: 2nd Year- Even
1.4 Prerequisite: Thermodynamics, Heat and Mass Transfer
1.5 Syllabus Committee member: Dr M S Balathanigaimani, Dr Deepak Dwivedi

2. **Objective:** To provide knowledge, understanding, and application-oriented skills on all fossil fuels resources and renewable energy sources and relevant technologies towards their effective utilization for meeting energy demand.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Conventional Resources	Principles of Combustion: Solid, liquid and gaseous fuels – types and combustion Combustion appliances for solid, liquid and gaseous fuels,	2
		Coal: Preparation carbonization, gasification and liquefaction of coal and lignite	2
		Gaseous fuels including natural gas, shale gas and uses and potential, Gas hydrates	2
2	Non-conventional Resources	Solar Energy: Introduction, Solar thermal systems Solar thermal power generation, Solar P.V.	4
		Biomass: Biomass Resources, Biomass Thermal Conversion, Biomass Combustion, Biomass Gasification, Biomass Pyrolysis, Biofuel, Advantages and Disadvantages of Biofuels	3
		Biogas: Aerobic and Anaerobic bio conversion processes, Microbial reactions purification, Properties of biogas Storage and Enrichment	3

		Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system, system efficiency	2
		Geothermal: Geothermal regions, Geothermal Resources and Capabilities, Types of geothermal resources, Analysis of geothermal resources, Geothermal regions, Geothermal systems/fields, dry rock and hot aquifer analysis, Geothermal energy conversion technologies.	3
		Nuclear Fusion: Introduction, Basic concepts, Fusion reaction physics, Thermonuclear reaction criterion, Confinement schemes, Inertial and magnetic confinement fusion, Nuclear Reactors and Nuclear wastes	3
3	Energy Economics	Costs of exploration and economics of utilization of depletable and renewable resources Energy demand supply balancing, Energy - economy interaction, Global supplies, Energy investment planning, Energy environment interaction, Energy Pricing and auditing	4
		Total Theory Hours	**28**
	Practical	1. Demonstration of polymer electrolyte membrane (PEM) fuel cell for energy generation 2. Ultimate analysis of biomass using CHNS analyzer 3. Determination of cloud and pour point using laser scattering technique 4. Determination of calorific value of solid/liquid fuels using bomb calorimeter. 5. Determination of flash point and fire point of liquid fuels/lubricants using Pesky Martens test. 6. Carbon residue test: liquid fuels. 7. Determination of viscosity of liquid lubricants and fuels using Saybolt viscometer. 8. Determination of viscosity of liquid lubricants and fuels using Red Wood viscometer-I & II. 9. Determination of viscosity of liquid lubricants and fuels using Engler viscometer. 10. Determination of calorific value of gaseous fuels using Junkers gas calorimeter. 11. Assembling of a calorimeter using Erlenmeyer flask to determination the energy contained in various biomass materials.	

		12. Synthesis and characterization of biofuels 13. Application of gas chromatography in biogas analysis **Out of 13 experiments, 10 experiments will be conducted.**	
		Total Practical hours	**10×2=20**
		Total	**48**

4. Readings

4.1 Text Books:

1. Sarkar, S., “Fuels and Combustion” Orient Longman, 2nd Editions, 1990
2. 2. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Resources Basic Principles and Application”, Narosa Publishing House 2005
3. 3. Mohan Munasinghe, Peter Meier. Energy Policy analysis and Modelling: Cambridge University Press1993

4.1 Reference Books:

1. Francis Peter, “Fuels and Fuel Technology”, 1st Edition, A.Wheatan & Co. Ltd. Of Exefer, 1965
2. W. Francis and M. C. Peter, “Fuels and fuel technology a summarized manual”, Pergamon Press, Second Edition (1980).
3. J. A. Duffie and W.A. Beckman, “Solar Engineering and Thermal Processes”, 2nd Edition John Wiley and sons.
4. John Twidell and Tony Weir, “Renewable Energy Resources” Taylor and Francis Group 2007
5. Gerand J. Mangone, “Energy Policies of the world” Elsevier.

5. Outcome of the Course: The course will provide learning about different conventional and renewable energy resources such as solid, liquid, gaseous fuels, their origin, composition, classification, combustion & conversion processes. energy technologies and provide adequate inputs on a variety of issues, global energy supplies and economics. The course will enable students to evaluate detailed techno - economic aspects of various energy technologies and systems.