Course title: Firm and Dispatchable Energy – Resources, Technology, Applications			
Course code: DSE 111	**No. of credits:** 3	**L-T-P:** 37-08-00	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: Sustainable Engineering			
Course coordinator: Prof. Naqui Anwer		**Course instructor:** Prof. Naqui Anwer, Dr. Lakshmi Raghupathy and Dr. Asif Nazar	
Contact details: naqui.anwer@terisas.ac.in			
Course type: Core		**Course offered in:** Semester 2	

Course Description:

The firm and dispatchable power are very much essential for the stability of the grid. In view of the increased penetration of variable renewable energy resources like wind power and solar power, the role of the firm and dispatchable power has increased considerably. This course introduces a mix of renewable and conventional energy that fall under the category of firm and dispatchable power. The students in this course will be able to appreciate the resources, technologies, and applications surrounding these sources of energy.

Course objectives:

- To familiarize students with the concept and need of firm and dispatchable power
- To understand the resources, technology, and applications of firm and dispatchable power.
- To understand the global and Indian scenarios of these resources
- To impart knowledge about dispatchable renewable energy
- To understand fossil fuels as well as nuclear energy

Course content

Module	Topic	L	T	P
1.	**Fossil Fuels** • Coal: Properties of coal, formation of coal, calorific value of coal • Natural Gas: Properties of natural gas, Natural gas resources in India • Coal-based power plant • Natural Gas based power plants	8	2	0
2.	**Nuclear Energy** • Fundamentals of Nuclear Energy • Nuclear Fission • Nuclear energy scenario: Global and India • Classification of nuclear reactors: Fast breeder reactors, thermal reactors • Components of nuclear reactor • Nuclear Reactors • CANDU reactor (Pressurized heavy water reactor)	7	2	0
3.	**Biomass** • Biomass resources • Classification of biomass resources • Biomass resource assessment • Combustion, pyrolysis, Gasification • Biomass processing • Stoves	8	2	0
4.	**Hydro Power** • Hydro resource and assessment • Hydropower turbines: Pelton wheel, Francis turbines and Kaplan turbines	7	2	0

	• Components of micro-hydro power plant			
5.	**Geothermal Energy** • Geothermal resources • Classification of geothermal resources • Geothermal energy in India • Advantages and disadvantages of geothermal energy over other energy forms • Gysers, Hot spring, Fumarole • Geothermal power plants	7	0	0
	Total	37	08	00

Evaluation criteria

Minor Test 1: Assignment (after completion of modules 1, 2 and 3)- 20%
Minor Test 2: Written test (after completion of modules 1, 2, 3 and 4)- 25%
Minor Test 3: Written test/ Case Study Presentation (after completion of modules 5 and 6)- 25%
Major Test: Written test/ Presentation (after completion of all modules) - 30%

Learning outcomes

- Appreciate the distinction between dispatchable and non-dispatchable energy
- Understand the significance of firm and dispatchable power
- Understand technology and applications of firm and dispatchable power

Pedagogical approach

A combination of class-room interactions, tutorials, group discussions assignments, expert talks / site visits

Materials:

Text Books:

Mehmet Kanoglu, Yunus A. Cengel and John M. Cimbala: **Fundamentals and applications of Renewable Energy** (McGraw Hill, 2020).
P K Nag: **Power Plant Engineering** (McGraw Hill, 2017).

Reference Books:

V.V.N. Kishore: Renewable Energy Engineering and Technology (Routledge, 2017)

Websites:

Additional information (if any): N.A.

Student responsibilities

Attendance, discipline, feedback as per TERI SAS rules

Course reviewers:

1. Prof. Sadhan Mahapatra, Tejpur University
2. Prof. Ramesh Narayanan, IIT Delhi