Course title: Energy and environmental implications			
Course code: ENR 148	**No. of credits:** 2	**L-T-P:** 30-0-0	**Learning hours:** 30
Pre-requisite course code and title (if any): N.A.			
Department: Sustainable Engineering			
Course coordinator: Dr. Sapan Thapar	**Course instructor(s):** Prof. D K Sharma		
Contact details: sapan.thapar@terisas.ac.in			
Course type: Core	**Course offered in:** Semester 1		

Course description

The course discusses and analyse the role of energy in the development of India. The focus of the course is on the conventional energy sources & their conversion technologies as well as the environmental impacts including global warming and climate change.

Course objectives

The objective of the courses is to develop understanding for the following:

- Utilization of conventional energy sources - coal, oil & natural gas, nuclear and hydro
- Environmental implications due to use of conventional energy resources

Course contents

Module	Topic	L	T	P
1	**Overview of Energy Sector – Global & Indian Context**	2	0	0
	COAL			
2	**Coal Basics** Formation of coal World and domestic reserves of coal Production & imports of coal Coal types, coal characteristics and properties Quality of Indian coals	2	0	0
3	**Coal Utilization Technologies** Uses of coal Coal washing, pyrolysis, combustion gasification, liquefaction, Coal bed methane, ash utilisation	2	0	0
4	**Environmental Aspects and Clean Use of Coal** Environmental impacts of coal mining and combustion and pollution control measures Clean coal technologies Carbon dioxide capture, storage and utilization	3	0	0
	OIL & NATURAL GAS			
5	**Basics** Formation of oil and natural gas Reserves of oil and natural gas Production, imports of oil & gas	2	0	0
6	**Uses &Environmental Aspects** Use of petroleum products as fuels and feedstock Uses of natural gas, LNG, CNG, LPG Oil Refining Environmental aspects of oil and natural gas	2	0	0

	NUCLEAR			
7	**Basics** Overview on Radioactivity -half- life, nuclear decay, nuclear reactions Uranium and thorium reserves Nuclear Reactors and technologies	3	0	0
8	**Fuel Processing and Safety** Nuclear fuel cycle Nuclear fuel reprocessing, safety & nuclear waste management	2	0	0
	HYDRO			
9	**Basic & Technology** Basic concepts, hydro potential and exploitation in India Major hydroelectric power plants in India Components of hydroelectric power plant: weir/intake, channel, desilting, forebay, spillway, penstock, turbine – Impulse and Reaction, generator, governor	5	0	0
10	**Environmental Issues** Environmental issues Constraints and problems Future Prospects	3	0	0
	ENERGY AND CLIMATE CHANGE LINKAGES			
11	Energy and carbon emissions International Response to Climate Change – UNFCCC SDGs and Energy - Accessibility, affordability reliability and sustainability	4	0	0
		30	**0**	**0**

Evaluation criteria

- Assignments: (after completion of module 6) - 20%
- Minor test 1: (after completion of modules 1, 2, and 3) - 20%
- Minor test 2: (after completion of modules 4, 5, 6, and 7) - 20%
- Major test: (at the end of the semester after completion of all modules) - 40%

Learning outcomes

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

- To understand the energy systems. (Minor test 1)
- Quantify the scale of pollution from a conventional Energy source. (Minor test 2 and Major test 3)
- Identify strength and weak-linkages in the energy systems. (Minor test 2 and Major test 3)

Pedagogical approach

A combination of class-room interactions, tutorials, assignments and projects.

Materials

Recommended readings

Rao. S and Parulekar B.B., "Energy Technology", Khanna Publishers
Bernard R Cooper and William A Ellingson, "The Science & Technology of Coal and coal utilization"Edited, ISBN0-306-41436.8, Plennwell
Pradip Kumar Das & Hrishikesh, "Petroleum and Coal", ISBN 81-7533-042-2, MD Deshpande, B G, "The World of Petroleum"
Yadav, M S, "Nuclear Energy and Power" SBS Publishers & Distributors Pvt. Ltd.
Jack J Fritz, "Small and Mini Hydropwer system", ISBN 0-07-022470-6, MC Graw Hill

Reference Books

Bruce G Miller, "Coal Energy System", ISBN 0-12-497451-1, Elsevier Academic Press
William L Leffler, Petroleum Refining, ISBN 0-87814-776-4, Pennwell
Dr. Duncan Seddon, "Gas Usage and Value", ISBN 1-59370-073-3, Pennwell Raymond L Murray, NuclearEnergy, Pergamon Press
Small Hydropower Initiative and Private Sector Participation, Alternate Hydro Energy Centre, IIT Roorkee
Charles Simeons, "Hydropower-The use of water as an alternate source of energy", ISBN 0 08 023269 8 Pergamon press
Douglas M Considine, Energy Handbook, Mc Graw Hill
Editor in Chief- Cutler J Cleveland, "Encyclopedia of Energy", Elsever Academic PressWiley Encyclopedia Series, Energy, Technology & Environment

Websites

coal.nic.in,
worldcoal.org,
petroleum.nic.in,
dae.gov.in
npcil.nic.in,
nhpcindia.com
https://cimfr.nic.in/

Additional information (if any)

Student responsibilities

Attendance, feedback, discipline: as per university rules.

Course reviewers

- Dr O. Prasada Rao, Scientist 'F' Council of Scientific & Industrial Research (CSIR), Retd.
- Dr Subhasis Maji, Indira Gandhi National Open University (Retd.)