Course no.:	ENR 129
Course title:	Renewable energy and fossil fuels based thermal power generation
Core or Elective:	Elective
Number of credits:	3
Number of lectures-tutorials-practicals:	30-12-0
Course coordinator:	Dr. YP Abbi

Course Objectives:

The course is designed to familiarize the students with basic design concepts of thermal power generation from solar thermal, coal/lignite, biomass, oil/natural gas, and geothermal energy sources. It will cover thermodynamics of Rankine and Brayton cycles for electric power generation, design of major equipment and sub-systems of power plant with each energy source, energy audit of thermal power plants. The course will also include concept of cogeneration with biomass and other fuels, and use of Organic Rankine cycle for power generation using low temperature heat source like Ocean Thermal Energy.

Evaluation procedure:

- Assignments: 20%
- Minor tests: 30%
- Major test: 50%

Details of course content and allotted time

	Topic	**Allotted time (hrs)**		
		L	**T**	**P**
1	Rankine, Brayton and Combined Cycle concepts	2	-	
2	Rankine cycle efficiency improvement through steam reheating, feed water heating, and condenser pressure/cooling water temperature control	2	-	
3	Design concepts of fossil fuel and biomass fired boilers, and its auxiliaries such as mills, fans, and boiler feed pump	6	2	
4	Steam generation through solar energy	2	-	
5	Steam generation through geothermal resources	2	1	
6	Organic Rankine cycle for using low temperature heat eg Ocean Thermal for power generation	2	-	
7	Design concepts of steam turbine and its auxiliaries such as condensers (water and air cooled), cooling towers, cooling water pumps, etc.	4	2	

	Topic	Allotted time (hrs)		
		L	T	P
8	Water systems in a thermal power plant (Raw water, DM water, Auxiliary cooling water)	2	-	
9	Evaluation of thermal efficiency of boilers	2	2	
10	Evaluation of heat rate of steam turbines	2	1	
11	Steam turbine and gas turbine based cogeneration systems	2	2	
12	Gas/oil based combined cycle power generation system	2	2	
	Total	**20**	**22**	**0**

Reference literature

- **STEAM** – its efficient generation and use, Babcock & Wilcox, 40th edition, 1992
- **Boiler and Auxiliaries** – a guide to equipment familiarization for customer training programme, Bharat Heavy Electricals Limited, Tiruchirapalli, India, 1978
- Yahya, S. M., **Turbines, Compressors, and Fans**, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002
- Bloch, Heinz P., '**A practical guide to steam turbine technology**', McGraw Hill publishing Company, 1996
- Bloch, Heinz P. and Singh, Murari P., '**Steam Turbines – Design, applications, and rerating**', McGraw Hill Publishing Company, 2009
- Raja, A. K., et al, '**Power Plant Engineering**', New Age International (P) Limited, Publishers, Lucknow, 2006
- Dadhich P K, "**Cogeneration– Policies, potential, and technologies**" Proceedings of Cogen India 96, March 10-12, 1996, published by TERI, 1997.
- Boyce, Meherwan P., **'Gas Turbine Engineering Handbook'**, 1992, Gulf Publishing Company, Houston, USA
- Kehlhofer, Rolf, 'Combined-cycle Gas & Steam Turbine Power Plants', 1991, The Fairmont Press, Inc., Lilburn, USA
- Performance Test Code for Fired Steam Generators -- ASME PTC 4 – 1998
- PK Nag: **Power Plant Engineering**, Third Edition (*Tata McGraw-Hill, 2007*)
- SR Turns: **An Introduction to Combustion: Concepts and Applications**, Second Edition (*McGraw Hill, 2000*)
- YP Abbi and Shashank Jain: **Handbook on Energy Audit and Environment Management**, (TERI Press, 2006)
- JA Duffie and WA Beckman: **Solar Engineering of Thermal Processes**, Third Edition (John Wiley & Sons)
- S Sukhatme and J Nayak: **Solar Energy: Principles of Thermal Collection and Storage**, Third Edition (Tata McGraw Hill, 2008)

- **Renewable Energy Engineering and Technology – A Knowledge Compendium**, ed. VVN Kishore (TERI Press, *2008*).