Course-Plan

School: Engineering
Department: Mechanical Engineering
Course Code: ME:528
Course Name: Energy Conservation and Waste Heat Recovery
L-T-P-C-Cr: 3-0-0-3-3

Instructor: Dr. Prabin Haloi

1. Abstract

The course Energy Conservation and Waste Heat Recovery (WHR) is associated to most of branches of study and application areas. Energy conservation may be considered as an essential method to improve energy efficiency, and to reduce cost of operation. Following it helps to minimize energy consumption, and also mitigate the harmful effects on environment. The waste heat recovery methods can capture and make reuse of otherwise waste energy of different processes. Both energy conservation and recovery of the waste heat will allow achieving sustainable energy growth, will contribute towards economic development, enhances the efforts towards a sustainable environment mitigating climate changes

2. Objectives

The course will have the following objectives-

(i) Discuss the need of energy conservation.
(ii) Explain the various sources of waste heat and their utilization.
(iii) Discuss the different waste heat recovery systems, their associated components and their operating principles.
(iv) Explain the methods of analyses of waste heat recovery systems.
(v) Enable students to be confident while dealing with waste heat recovery systems.
(vi) Enable students to be practically competent to analyse and solve problems associated with waste heat recovery systems.

3. Prerequisites of the course : None

4. Course Outline:

- Introduction
- Energy utilization
- Waste heat recovery systems
- Heat pipes and pumps
- Energy storage

5. Time Plan

Topic	Contents	Contact Hours			
		L	T	P	C
Introduction	Energy resources and use, potential, fossil fuels, total energy approach. Energy conservation: definition, achievement and effects, energy conservation policy and issues.	1	0	0	1
	Sources of waste heat, importance of waste heat recovery	2	0	0	2
Energy utilization	Rebound effect: definition, types, causes and implications, mitigation methods, calculations	2	0	0	2
	Khazzoom - Brookes postulate: concept, relationship to rebound effect, implications, limitations, energy consumption and efficiency relation	2	0	0	2
	utilization of industrial waste heat, optimal utilization of fossil fuels. Review of fundamental laws of thermodynamics.	4	0	0	4
	Coupled cycles and combined plants, cogeneration systems. Exergy analysis. Utilization of low grade reject heat from power plants, thermoeconomic optimization	5	0	0	5
	Exhaust gas: properties, heat recovery systems	2	0	0	2
Waste heat recovery systems	Heat exchangers: recuperators and regenerators, shell and tube heat exchangers, spiral tube and plate heat exchangers.	4	0	0	4
	Waste heat boilers-types and design aspects, use heat pump for energy recovery, heat recovery from incineration plants.	3	0	0	3
	Fluidized bed heat recovery systems, thermoelectric system to recover waste heat.	3	0	0	3
	Utilization of waste heat in refrigeration, heating, ventilation and air conditioning (HVAC) systems.	3	0	0	3
Heat pipes and pumps	Heat pipes: theory and applications of heat pipes, types, waste heat recovery using heat pipes. Heat pumps: types and methods for energy recovery.	6	0	0	6
Energy Storage	Need for energy storage, applications and advantages in waste heat recovery, energy storage technology for waste heat recovery, limitations.	3	0	0	3

Text Books and References:

1. Ganapathy, V. Steam generators and waste heat boilers for process and plant engineers (CRC Press, 2015)
2. Ehringer, H.; Hoyaux,G.; Pilvachi, P.A. Energy conservation in industrycombustion, heat recovery and rankine cycle machines (D.Reidel,1983) 3
3. Harlock, J.H. Combined Heat and Power (Pergamon Press, 1997)
4. Kennedy, W.F. Energy conservation in process industries (Academic Press 1984)
5. Pilavachi, P.A. Energy efficiency in process industries(Elsevier applied science,1993)
6. Kreith, F. and West, R.E. Energy Efficiency, CRC handbook (CRC Press,1999)
7. Kays and London, Compact Heat Exchangers (McGraw-Hill, New York, 3/e, 1958)

6. Pedagogy:

In this course, the teaching-learning methods to be used are as follows:

- Lecture and discussion/questioning
- Class test, quizzes
- Mid and end semester test
- Laboratory /field visit
- Presentation/seminar /Assignments

7. Expected Course Outcomes (COs):

Towards the end of the course the students will be:

- Understand the need of energy conservation.
- Identify the types of waste heat recovery systems and their components.
- Identify problems associated with heat recovery systems.
- Apply their knowledge and understanding to analyse and design such systems as per requirements.
- Be competent to practically solve associated problems of waste heat recovery systems.