

King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME 437: Design and Rating of Heat Exchangers

Catalogue Description: (3-0-3)

Heat transfer mechanisms leading to basic heat exchanger equations, classification and analysis of heat exchangers including geometry; heat transfer and flow friction characteristics; compact and shell-and-tube heat exchanger application and design procedures; fouling and its effect on life cycle analysis; maintenance methodology; flow-induced vibration and noise in heat exchangers.

Status in Curriculum (Required or Elective): Elective (offered Fall)

Prerequisites: ME 315

Co-requisites: None

Prerequisites by Topics:

- Conservation of mass and energy (ME 203, ME 311)
- Varies laws of Conduction, Convection, and Radiation (ME 315)

Textbook: S. Kakac, and L. Hongtan, A. Pramuanjaroenkij, Heat Exchangers – Selection, Rating, and Thermal Design, 3rd Edition, CRC Press, Boca Raton, 2012

References:

1. G. F. Hewitt, G. L. Shires, and T. R. Bott, Process Heat Transfer, CRS Press, Boca Raton, USA, 1994.

Coordinator:Dr. Syed M. Zubair, Professor of Mechanical Engineering

Goals:(general objectives)

Introduce basic principles of heat transfer, fluid mechanics and engineering thermodynamics knowledge into overall design of various types of heat exchangers. Teach students to handle design and performance evaluation problems of various class of heat exchangers. Familiarize students with engineering equation solver and its use in heat exchanger design and rating problems.

Course Outline (Lecture Topics):

1. Basic mechanisms of heat transfer, such as conduction, convection, boiling, condensation, and radiation (5 hours)
2. Classification of heat exchangers according to flow (3 hours)
3. Heat exchanger analysis using LMTD, NTU-R-P-F and ϵ -NTU methods (5 hours)
4. Selection criteria of heat exchangers (2 hours)
5. Thermal-hydraulic and mechanical design of shell-and-tube heat exchangers (5 hours)
6. Design and analysis of double-pipe heat exchangers (5 hours)
7. Design and performance evaluation of finned-tube heat exchangers (5 hours)
8. Performance evaluation of plate-fin heat exchangers (5 hours)
9. Design considerations in boilers and condensers (3 hours)
10. Fouling growth models and its impact on heat exchanger performance and life-cycle analysis (2 hours)
11. Flow-induced vibration (2 hours)

Design Activities/Projects:

The aim of the project is to increase the student ability to solve real world heat exchanger design and rating problems.

Computer Usage:

Students are encouraged to solve all homework problems using the available engineering software, such as EES.

Laboratory: None

Assessment Tools:

- i- Mid-term Examinations
- ii- Homework Assignments
- iii- Quizzes
- iv- Final Exam

Course Learning Outcomes:

- I- Demonstrate basic understanding of several types of heat exchangers that will include double pipe, shell-and-tube, plate-and-frame, plate fin and finned tube heat exchangers.
- II- Identify capabilities and limitations of different configuration of heat exchangers in terms of their performance, maintenance and economic considerations, etc.
- III- Demonstrate importance of appropriate fouling allowance in design of heat exchangers.
- IV- Explain how to maximize the performance of a heat exchanger operating in a thermal system.
- V- Demonstrate ability to use EES and EXCEL in solving open-ended design problems.

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course-to-Student outcome mapping	I, II, IV	--	II, III	III	II, III, IV	--	II, III, IV, V	--	III	--	V
Emphasis*	M		M	M	S		L		L		S

* L:: Little/None M: Moderate S: Strong

Status of Continuous Improvement review of this Course:

Date reviewed: -----
Prepared by: Dr. Syed M. Zubair

Reviewed by: Heat Transfer Group
Date prepared: March 01, 2015