The University of Jordan
School of Engineering
Chemical Engineering Department

Program: B.Sc.
Academic Year:
Semester:

CHE 0905343: Process Heat Transfer
Course Catalog (2019)

Types of heat exchangers, design of heat exchangers: double-pipe exchangers, shell-and-tube exchangers. Cross flow heat exchangers. Plate heat exchangers, Single and multicomponent condensation and boiling. Design of condensers and vaporizers. Radiation in heat transfer processes. Design of fired heaters and furnaces. Jacketed vessels and tube coils.

Credit hours	3	Level	3	**Pre-requisite(s)**	**0905341**
Instructor **Prof. Yahya Khraisha**		**Office number** **CHE000**		**Office phone** 06/5355000 Ext. 22881	
Course website https://elearning.ju.edu.jo/login/index.php Live Streaming Platform: Microsoft Teams		**E-mail** **khraisha@ju.edu.jo**		**Place** Refer to Registration website	

Textbooks:

1. Hewitt, G.F., Shires, G.L. and Bott, T.R., "Process heat transfer", CRC Press, 1994.
2. Instructor Handouts.

References:

1. Robert Serth and Thomas Lestina, Process Heat Transfer, 2nd edition, Academic Press, 2014.
2. Heat and Mass Transfer –Fundamentals and applications, 5th ed., Çengel, Y.A. and Afshin J. GhajarMcGraw –Hill, New York, 2014.
3. Incropera F., DeWitt D. , Bergman, Lavine, Fundamentals of Heat and Mass Transfer, 7th edition, John Wiley Son, New York, 2011.
4. Holman J P (2008), Heat Transfer, 9th edition, McGraw-Hill, 2008.
5. Coulson, J. M. & Richardson, J. F. (2003). Chemical engineering (vol. 6), Pergamon Press, Oxford.

Learning Objectives and Intended Learning Outcomes

Objectives	Outcomes
1. An ability to understand the different types of heat exchangers.	understand how to classify the different types of heat exchangers and to select the appropriate type of heat exchanger. [O1]
2. An ability to recognize the different methods of obtaining the heat transfer coefficients.	recognize the different methods of obtaining the heat transfer coefficients for internal and external flow through circular and non-circular

	conduits: exact and empirical correlations as well as chart methods. [O1]
3. An ability to understand the basic theory of heat exchangers.	identify the basic theory of heat exchangers. [O1]
4. An ability to understand the thermal and mechanical design of bank of tubes, double pipe and shell-and-tube heat exchangers.	perform the mechanical and thermal design of the bank and double pipe heat exchangers. [O1]
5. An ability to understand the basic theory of heat transfer of boiling and condensation processes.	analyze the basic theory of boiling and condensation and perform the thermal design of shell-and-tube condenser and reboiler. [O1]
6. An ability to understand the thermal and mechanical design of condensers and reboilers.	understand the mechanical and thermal design of the shell-and-tube heat exchangers. [O1]
7. An ability to understand the basic theory of radiation between surfaces and the design of pipestill heaters.	analyze the basic theory of radiation between surfaces and understand the different models of furnaces as well as furnace calculations. [O1]
8. Enhance the ability of students for life-long learning and communication skills.	Enhance students' skills through intensive use of available data resources and short projects with written and oral presentations (O7)

Topics Covered

Week	Topics	Ref.
1	Introduction and Syllabus. Applications of heat transfer in process industries; Mechanism of heat transfer; Heat exchangers process configuration, classification and enhancement.	Handouts, Textbook
2	Heat transfer coefficients for internal and external flow through circular and non-circular conduits: exact and empirical correlations and chart methods.	Handouts, Textbook
3	Heat transfer in cross-flow exchangers (tube bank); in-line, staggered and finned tube arrays. Calculations of pressure drop in cross-flow tube array.	Handouts, Textbook
4-5	Basic theory of heat exchangers: overall heat transfer coefficient, fouling factors, temperature profiles for pure counter and cocurrent flows, area calculation general method, maximum heat transfer rate, effectiveness and number of transfer unit.	Handouts, Textbook
6-7	Double pipe heat exchangers: mechanical design (straight tube and U-tube exchanger and multi-tube units and fins); thermal design and performance (finding the size for a specific duty and calculating the performance of a given size). Parallel/series arrangements	Handouts, Textbook

8-10	Shell-and-tube heat exchanger: basic mechanical feasures, heat transfer and pressure loss calculations (Kern method, Bell-Delaware method, flow steam analysis Method), Rating and design of shell-and-tube exchangers.	Handouts, Textbook
11-13	Boiling and condensation heat transfer: Pool and forced convection boiling, multicomponent boiling, correlations for boiling coefficients and maximum heat flux. Mode of condensation, filmwise on vertical and horizontal single and multiple tubes, condensation in multicomponent system. Shell-and-tube condensers.	Handouts, Textbook
14-16	Radiation and furnaces: thermal radiation and properties; blackbody radiation; View factor and radiation between surfaces; combined radiation and convection; types of furnaces in process plants; typical excess air values; mean beam lengths and total gas absorptivity; interception factor and effective emissivity of tube bank; furnace models "well stirred furnace model" and "plug-flow furnace model".	Handouts, Textbook

Evaluation

Evaluation Tool	Weight	Date
Midterm Exam	30	Will be announced by the department
Project	10	Will be arranged between the 5th and 16th weeks
Presentations	5	To be arranged one week after the assignment
Quizzes	5	-
Final Exam	50	Will be announced by the University

Relationship to Program Outcomes

01	02	03	04	05	06	07
x						x

Relationship to CHE Program Objectives

PEO1	PEO2	PEO3	PEO4	PEO5	PEO6	PEO7	PEO8	PEO9	PEO10	PEO11
√	√	√		√						

Document Control

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