The University of Jordan

School of Engineering

Electrical Engineering Department

2nd Semester – A.Y. 2023/2024

Course:	**Process Heat Transfer – ChE0905343 (3 Cr. – RequiredCourse)**
Instructor:	Prof. Y. Khraisha
	Office: ChE000, Telephone: 06/5355000 ext 22722, Email:khraisha@ju.edu.jo
	Office Hours: Sun Tue Thu 10:00-11:00, Wed 12-13:00
Course website:	http://elearning.ju.edu.jo
Catalog description:	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.

Prerequisites by course:	**ChE**	**0905341**	Transport Phenomena 1	(pre- or co-requisite)

Prerequisites by topic:	Students are assumed to have sufficient knowledge pertaining to the following: 1.Tranport Phenomena 1 2. Fluid Mechanics
Textbook:	**Hewitt, G.F., Shires, G.L. and Bott, T.R., "Process heat transfer", CRC Press, 1994.**

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.
		6.	Course Handout.
Schedule:		48 lectures (45 minutes)	
Course goals:		1. An ability to understand the different types of heat exchangers. 2. An ability to recognize the different methods of obtaining the heat transfer coefficients. 3. An ability to understand the basic theory of heat exchangers. 4. An ability to understand the thermal and mechanical design of bank of tubes, double pipe and shell-and-tube heat exchangers. 5. An ability to understand the basic theory of heat transfer of boiling and condensation processes. 6. An ability to understand the thermal and mechanical design of condensers and reboilers. 7. An ability to understand the basic theory of radiation between surfaces and the design of pipe still heaters.	
Course learning outcomes (CLO) and relation to ABET student outcomes (SO):			
Upon successful completion of this course, a student should:			**[SO]**
1.	understand how to classify the different types of heat exchangers and to select the appropriate type of heat exchanger.		**[1, 2]**
2.	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.		**[1, 2]**
3.	identify the basic theory of heat exchangers.		**[1, 2]**
4.	perform the mechanical and thermal design of the bank and double pipe heat exchangers.		**[1, 2]**
5.	understand the mechanical and thermal design of the shell-and-tube heat exchangers.		**[1, 2]**
6.	analyze the basic theory of boiling and condensation and perform the thermal design of shell-and-tube condenser and reboiler.		**[1, 2]**
7.	analyze the basic theory of radiation between surfaces and understand the different models of furnaces as well as furnace calculations.		**[1, 2]**

Course topics:		Hrs
1.	Applications of heat transfer in process industries; Mechanism of heat transfer; Heat exchangers process configuration, classification and enhancement.	**3**
2.	Heat transfer coefficients for internal and external flow through circular and non-circular conduits: exact and empirical correlations and chart methods.	**3**
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.	**4**
4.	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.	**8**
5.	Double pipe heat exchangers: mechanical design (straight tube and U-tube exchanger and multitube 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	**4**
6.	Shell-and-tube heat exchanger: basic mechanical features, heat transfer and pressure loss calculations (Kern method, Bell-Delaware method, flow steam analysis Method), Rating and design of shell-and-tube exchangers.	**8**
7.	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.	**8**
8.	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".	**7**

Ground rules:	Attendance is required and strictly enforced. To that end, attendance will be taken every lecture; Absence of more than 5hours will result in the expulsion of the student from the course.

Assessment & grading policy:	Assignments	0%	Quizzes and inclass activities		10%		
	Midterm	30%	Projects (SO-G,H)		10%		
	short t Exam	0%	Lab Work		0%		
	Final Exam	50%	Presentation		0%		
				Total	**100%**		

Last Revised:	May 10, 2024