

## (Heat and Mass Transfer) Course Catalogue

### 2023-2024

College	Erbil College of Technology	
Department	Petroleum Technology	
Module Name	Heat and Mass Transfer	
Module Code	HMT203	
Semester	2	
Credit	5	
Module type	Assist.	
Weekly hours	2	
Weekly hours (Theory)	(2) hr Class	(146)hr Workload
Weekly hours (Practical)	( )hr Class	( )hr Workload
Lecturer (Theory)	Dr Shara Kamal Mohammed	
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Lecturer (Practical)		
Email		

## Course Book

### Course overview:

- This course provides a fundamental understanding of heat and mass transfer in the downstream oil industry, particularly in refinery units. It presents theoretical background besides modules to calculate energy balance in the operation units. For this reason, problems and solutions are included throughout the course.

### Course objective:

The objectives of the course are to

1. learn different methods and theories of heat and mass transfer.
2. understand heat and mass transfer process in refinery
3. provide knowledge of heat transfer through conduction, convection & radiation
4. Calculate temperature and heat flux in one-dimensional conduction
5. Learn about heat exchanger design and understand the necessary equations to determine the heat transfer rate in different types of heat exchangers.
6. learn about radiation and its use in real life.
7. Learn the boiling and condensation processes and their applications in the refinery.
8. Understand the concentration and diffusion phenomena in liquid and gases

### Student's obligation

Students should be prepared for discussion during the class as they will be provided with the lecture in advance. They will be asked to solve problems during the class and will also be given homework for each subject. In addition, a continuous system of quizzes will be applied throughout the semester to evaluate students' progress. Finally, they will be asked to prepare reports and seminars.

**Forms of teaching**

lecture halls with data show equipment for lecture presentations, whiteboard, overhead projector, posters

**Assessment scheme**

24% Mid. Theory exam

8% Quiz

10% Homework

16% Reports and Seminars

2% Attendance

40% final theory

**Student learning outcome:**

At the end of the course, student will:

1. Understand the process of heat and mass transfer in refinery
2. Understand how heat & energy is transferred between elements of a system.
3. Be able to solve problems involving one or more modes of heat transfer.  
Students can learn about modes of heat transfer and conduction heat transfer.
4. Learn types of convection and dimensional analysis.
5. Learn phases of heat transfer in distillation towers
6. Be able to learn about heat exchanger types and performance.
7. Estimate the heat transfer rate for different heat exchangers
8. Will be able to learn different laws of Radiation and its applications.
9. Understand mass transfer and learn about its application.
10. Learn mass transfer process in refinery
11. Will learn the theories and the analytical methods of mass transfer in fluids, liquids and gases.

**- Course Reading List and References:  
References**

Incropera, F.P., DeWitt, D.P., Bergman, T.L. and Lavine, A.S., 2007. Fundamentals of Heat and Mass Transfer 6th Edition, Fundamentals of Heat and Mass Transfer.

Sukhatme, S.P., 2005. *A textbook on heat transfer*. Universities Press.

Cengel, Y.A., 1998. Heat transfer: a practical approach. (*No Title*).

Baukal Jr, C.E. ed., 2018. The Slipcover for The John Zink Hamworthy Combustion Handbook: Three-Volume Set. CRC press.

Trinks, W. and Mawhinney, M.H., 1967. INDUSTRIAL FURNACES, V 2. JOHN WILEY AND SONS, INC, NEW YORK, N. Y. 1967, 358 P.

**Textbooks:**

John, H.L.I.V., Lienhard, I.V. and Lienhard, V., 2008. A heat transfer textbook. *Phlogiston Press, Cambridge*.

**. Source links:**

1. <http://www.scopus.com>.

3. <http://www.sciencedirect.ru>.

Course topics (Theory)	Weak	Learning Outcome
<p><b>1. Introduction to heat transfer:</b></p> <p>What is heat, heat transfer definition. Units and dimensions, application of heat transfer, Types of heat transfer, Conduction, convection, and radiation, Problems and solutions.</p>	<b>1</b>	Understanding heat transfer
<p><b>2. Conduction heat transfer</b></p> <p>Fourier's law of heat conduction. Thermal Conductivity. Thermal resistance. One dimension</p>	<b>2,3</b>	Understanding conduction heat transfer equations

<p>heat conduction, conductive boundary conditions, overall heat transfer coefficient. Problems and solutions</p>		<p>and solving problems</p>
<p><b>3. Convection heat transfer</b></p> <p>Conductive heat transfer, convective heat transfer in flow through tubes and ducts, laminar flow in tubes and ducts, turbulent flow in tubes and ducts forced convection heat transfer in external flow Flat plate. Problems and solutions</p>	<p>4,5</p>	<p>Understanding convection heat transfer equations and solving problems</p>
<p><b>4. Radiation heat transfer</b></p> <p>Wave theory, particle theory, concept of black body, Stefan-Boltzmann Law, radiation properties. Problems and solutions</p>	<p>6</p>	<p>Understanding different theories of radiation heat transfer</p>
<p><b>5. Heat exchangers:</b></p> <p>Definition, classifications of heat exchangers. Types of heat exchangers, Overall heat transfer coefficient, The log-mean temperature difference LMTD, Parallel-flow heat exchangers, Counterflow heat exchangers. Problems and solutions</p>	<p>7</p>	<p>Understanding heat exchangers and overall heat transfer calculations</p>
<p><b>6. Boiling and condensation</b></p> <p>Boiling phenomena, different regimes of boiling, classification of boiling, Pool boiling, flow boiling, sub-cooled boiling, saturated boiling.</p> <p>Condensation heat transfer, forms of condensation: film condensation, dropwise</p>	<p>8</p>	<p>Understanding boiling and condensate phenomena besides the different regimes of boiling.</p>

