Module (Course Syllabus) Catalogue

2022-2023

College/ Institute	Koya Technical Institute	
Department	Petroleum Technology	
Module Name	Mass Transfer	
Module Code		
Degree	Technical Diploma • Bachler ☐ High Diploma ☐ Master ☐ PhD ☐	
Semester	4th	
Qualification	PhD	
Scientific Title	Lecturer	
ECTS (Credits)		
Module type	Prerequisite ☐ Core • Assist. ☐	
Weekly hours		
Weekly hours (Theory)	(2)hr Class	( )Total hrs Workload
Weekly hours (Practical)	(2)hr Class	( )Total hrs Workload
Number of Weeks	12	
Lecturer (Theory)	Dr. Barhm Abdullah Mohamad	
E-Mail & Mobile NO.	barhm.mohamad@epu.edu.iq 07512209152	
Lecturer (Practical)		
E-Mail & Mobile NO.		
Websites		

Course Book

<table>
<tr><td>Course Description</td><td colspan="5">This course will focus on the Demonstrating the basic concepts of mass transfer and covering process related to mass transfer such as distillation, absorption, extraction.</td></tr>
<tr><td>Course objectives</td><td colspan="5">• Providing knowledge about fundamentals of Mass transfer.
• Analysing how mass transfer occur.
• Educating students to solve problems.</td></tr>
<tr><td>Student's obligation</td><td colspan="5">• Attending classes and participate in the lecture.
• Make reports and studies on different topics.
• Assignment preparations.
• Make quizzes and exams to make sure they got necessary knowledges.</td></tr>
<tr><td>Required Learning Materials</td><td colspan="5">• Handouts, notes and references.
• Showing necessary videos and reports.
• Showing equipment on different sites if possible.</td></tr>
<tr><td rowspan="12">Evaluation</td><td colspan="2">Task</td><td>Weight (Marks)</td><td>Due Week</td><td>Relevant Learning Outcome</td></tr>
<tr><td colspan="2">Paper Review</td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">Assignments</td><td>Homework</td><td>5</td><td></td><td></td></tr>
<tr><td>Class Activity</td><td>2</td><td></td><td></td></tr>
<tr><td>Report</td><td>10</td><td></td><td></td></tr>
<tr><td>Seminar</td><td>10</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Quiz</td><td>8</td><td></td><td></td></tr>
<tr><td colspan="2">Lab.</td><td>15</td><td></td><td></td></tr>
<tr><td colspan="2">Midterm Exam</td><td>10</td><td></td><td></td></tr>
<tr><td colspan="2">Final Exam</td><td>40</td><td></td><td></td></tr>
<tr><td colspan="2">Total</td><td>100</td><td></td><td></td></tr>
<tr><td>Specific learning outcome:</td><td colspan="5">1- Theory of Mass transfer.
2- Analyzing problems.
3- Solving Mass transfer problems.</td></tr>
</table>

Course References:	1. Bejan, A. and Kraus, A.D. (2003) Heat and Mass Transfer Handbook. John Wiley and Sons, Hoboken. 2. Cengel, Y. A., & Ghajar, A. J. (2014). Heat and mass transfer: Fundamentals and applications (5th ed.). McGraw-Hill Professional.

Course topics (Theory)	**Week**	**Learning Outcome**
Introduction	1	General information about Mass transfer
Absorption/desorption	2	Importance of absorption/desorption
HTU/NTU/HETP concepts	3	
Distillation	4, 5, 6 & 7	Distillation types and columns
Extraction	8	Extraction basics
Humidification and Dehumidification	9 & 10	Humidification and Dehumidification
Drying	11	Basics of drying and application
Psychrometric Chart	12	Psychrometric Chart Principle and usages

Practical Topics	**Week**	**Learning Outcome**
The effect of varying water flow rate on the performance of mechanical draught cooling tower	1	The approaches of mechanical draught cooling tower
Estimate the evaporation rate of water (water loss) for the cooling tower	2 & 3	Factors affecting Water evaporations
Gas absorption in packed tower with Raschig rings packings	4 & 5	Absorption process and the function of packings
Rotary dryer	6	Study and analysing the rate of drying

Questions Example Design

Example: In an air-carbon dioxide mixture at 298 K and 202.6 kPa, the concentration of CO_2 at two planes (3 mm) apart are 25 vol.% and 15 vol.% respectively. The diffusivity of CO_2 in air at 298 K and 202.6 kPa is 8.2 $\times 10^{-6}$ m^2/s. Calculate the rate of transfer of CO_2 across the two planes, assuming:

a. Equimolecular counter diffusion.

b. Diffusion of CO_2 through a stagnant air layer.

Solution:

$P_{A1} = y_{A1} \cdot P_T = (0.25)\ 202.6 = 50.65$ kPa

$P_{A2} = y_{A2} \cdot P_T = (0.15)\ 202.6 = 30.39$ kPa

a. Equimolecular counter diffusion:

$$N_A = \frac{D_{AB}}{RT}\left[\frac{P_{A_1} - P_{A_2}}{z_2 - z_1}\right]$$

$$N_A = \frac{8.2\ X\ 10^{-6}}{8.314\ (298)}\left[\frac{50.65 - 30.39}{3\ X\ 10^{-3}}\right] = 2.23X10^{-5}\ \frac{kmol}{m^2.s}$$

b. Stagnant diffusion.

$$N_A = \frac{D_{AB}}{RT}\ \frac{P_T}{d_z}\ Ln\left[\frac{P_T - P_{A_2}}{P_T - P_{A_1}}\right]$$

$$N_A = \frac{8.2\ X\ 10^{-6}}{(8.314\ )(298\ )}\ \frac{202.6}{3\ X\ 10^{-3}}\ Ln\left[\frac{202.6 - 30.39}{202.6 - 50.65}\right] = 2.79\ X\ 10^{-5}\ \frac{kmol}{m^2.s}$$

Extra notes:
External Evaluator