



Ministry of Higher Education and  
Scientific Research - Iraq  
Al-Mustaqbal University  
College of Engineering and Technology  
Department of Chemical Engineering and  
Petroleum industries



## MODULE DESCRIPTOR FORM

### نموذج وصف المادة الدراسية

Module Information			
معلومات المادة الدراسية			
Module Title	Unit Operation I	Module Delivery	
Module Type	CORE	Lecture Lab Tutorial	
Module Code	UOMU0102063		
ECTS Credits	5		
SWL (hr/sem)	125		
Module Level	3		
Administering Department	Department of Chemical Engineering and Petroleum industries	College	College of Engineering
Module Leader	Dr. Haydar Alaa Salih Aljaafari	e-mail	haydar.alaa.salih@uomus.edu.iq
Module Leader's Acad. Title	Assist Prof.	Module Leader's Qualification	Ph.D
Module Tutor	Lec. Assis. Zainab Hassan		
Peer Reviewer Name	Dr. Alaa Thari Jawad	e-mail	alaa.thari.jawad@uomus.edu.iq
Review Committee Approval	2026/03/07	Version Number	1.0

<b>Relation With Other Modules</b> العلاقة مع المواد الدراسية الأخرى			
<b>Prerequisite module</b>	Mass Transfer, Chemical Eng. Principles III	<b>Semester</b>	
<b>Co-requisites module</b>	None	<b>Semester</b>	
<b>Module Aims, Learning Outcomes and Indicative Contents</b> أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية			
<b>Module Aims</b> أهداف المادة الدراسية	<ul style="list-style-type: none"> <li>Develop a strong conceptual and analytical understanding of distillation processes, covering differential, flash, and continuous multistage operations, vapor–liquid equilibrium (VLE), and the application of McCabe–Thiele, Underwood, and Gilliland methods for binary and multicomponent systems.</li> <li>Introduce the fundamental principles and design methodologies of tray and packed columns, including stage-wise and continuous contact operations, with emphasis on graphical and algebraic techniques for determining the number of stages and packing height under various flow regimes.</li> <li>Enable students to evaluate and apply mass transfer correlations and performance metrics, including tray efficiency, minimum liquid flow rate, and mass transfer coefficients, while integrating theoretical models with practical process design for separation systems.</li> </ul>		
<b>Module Learning Outcomes</b> مخرجات التعلم للمادة الدراسية	<p>By the end of this module, students will be able to:</p> <ul style="list-style-type: none"> <li>Analyze and design distillation systems, including differential, flash, and continuous multistage operations, using vapor–liquid equilibrium data and methods such as McCabe–Thiele, Underwood, and Gilliland correlations for both binary and multicomponent mixtures.</li> <li>Explain the principles and operational differences between tray and packed columns, including stage-wise and continuous contact operations, and apply graphical and algebraic methods to determine the number of stages or packing height under various flow conditions.</li> <li>Evaluate mass transfer performance and separation efficiency by applying empirical correlations, calculating tray efficiency, determining minimum liquid flow rates, and estimating mass transfer coefficients.</li> </ul>		
<b>Indicative Contents</b> المحتويات الإرشادية	<p><b>Chapter 1: Fundamentals of Distillation and VLE</b></p> <ul style="list-style-type: none"> <li>Basics of distillation and phase separation</li> <li>Core vapor–liquid equilibrium (VLE) concepts</li> <li>Introduction to Rayleigh and flash distillation</li> </ul> <p><b>Chapter 2: Stage-Wise Distillation and Tray Columns</b></p> <ul style="list-style-type: none"> <li>Principles of multistage distillation</li> <li>Tray column design and operation</li> <li>McCabe–Thiele method and feed stage selection</li> </ul> <p><b>Chapter 3: Analytical Methods and Packed Columns</b></p> <ul style="list-style-type: none"> <li>Total and minimum reflux concepts</li> <li>Underwood and Gilliland stage calculations</li> <li>Tray efficiency and non-ideal behavior</li> </ul>		

	<ul style="list-style-type: none"> <li>• Packed column design: HETP, HTU/NTU methods</li> </ul> <p><b>Chapter 4: Gas–Liquid Absorption Basics</b></p> <ul style="list-style-type: none"> <li>• Fundamentals of isothermal absorption</li> <li>• Single-stage and countercurrent absorption</li> <li>• Mass balances, operating lines, and equilibrium relationships</li> </ul> <p><b>Chapter 5: Minimum Solvent-to-Gas Ratio</b></p> <ul style="list-style-type: none"> <li>• Meaning and importance of minimum solvent flow</li> <li>• Tangency condition and limits of absorption</li> <li>• Graphical and analytical determination of <math>(L_s/G_s)_{min}</math></li> </ul> <p><b>Chapter 6: Determining Number of Absorption Stages</b></p> <ul style="list-style-type: none"> <li>• Kremser method using the absorption factor (<math>A = L/mG</math>)</li> </ul>
<p><b>Learning and Teaching Strategies</b></p> <p>استراتيجيات التعلم والتعليم</p>	
<b>Strategies</b>	<p>This module promotes active learning through weekly online exercises and monthly written assignments. Students will develop critical thinking and problem-solving skills via lectures, interactive tutorials, and practical problem-solving activities. A question-driven lecture style and peer discussions will further enhance engagement and understanding.</p>

<p><b>Student Workload (SWL)</b></p> <p>الحمل الدراسي للطالب</p>			
<p><b>Structured SWL (h/sem)</b></p> <p>الحمل الدراسي المنتظم للطالب خلال الفصل</p>	93	<p><b>Structured SWL (h/w)</b></p> <p>الحمل الدراسي المنتظم للطالب أسبوعياً</p>	6
<p><b>Unstructured SWL (h/sem)</b></p> <p>الحمل الدراسي غير المنتظم للطالب خلال الفصل</p>	32	<p><b>Unstructured SWL (h/w)</b></p> <p>الحمل الدراسي غير المنتظم للطالب أسبوعياً</p>	$32/15 = 2.13$
<p><b>Total SWL (h/sem)</b></p> <p>الحمل الدراسي الكلي للطالب خلال الفصل</p>	125		

<p><b>Module Evaluation</b></p> <p>تقييم المادة الدراسية</p>					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
<b>Formative assessment</b>	<b>Quizzes</b>	2	20%	Continuous	LO # <sup>1</sup> and 2
	<b>In class</b>	2	5%	Continuous	LO #3, 4 and 7
	<b>HW</b>	4	5%	Continuous	LO # <sup>1</sup> and 2
<b>Summative assessment</b>	<b>Midterm Exam</b>	1	10%	4, 8, 11	LO # <sup>1</sup> and 7
	<b>Final Exam</b>	3 hr	60%	16	All
<b>Total assessment</b>					

### Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction to Separation via Distillation
Week 2	Vapor-Liquid Equilibrium (VLE) Concepts
Week 3	Differential (Rayleigh) and Flash Distillation Principles
Week 4	Continuous Multistage Distillation
Week 5	Tray Column Configurations and Operating Principles
Week 6	McCabe-Thiele Graphical Method (Part I)
Week 7	McCabe-Thiele Method (Part II): Feed Stage and Operating Lines
Week 8	Total Reflux and Minimum Reflux Conditions
Week 9	Underwood and Gilliland Methods for Stage Calculation
Week 10	Tray Efficiency and Deviations from Ideality
Week 11	Packed Column Design: HETP and HTU/NTU Methods
Week 12	Packed Column Performance and Minimum Liquid Flow Rate
Week 13	Fundamentals of Isothermal Gas-Liquid Absorption
Week 14	Determination of Minimum Solvent-to-Gas Ratio $(L_s/G_s)_{min}$
Week 15	Analytical Methods to Determine the Number of Trays (Kremser Equation)

### Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	Guidance instructions for students to deal with laboratory and safety equipment.
Week 2	Liquid-Liquid diffusion
Week 3	Report discussion and assessment
Week 4	Absorption
Week 5	Report discussion and assessment
Week 6	Batch Distillation Column
Week 7	Report discussion and assessment
Week 8	Midterm exam

<b>Week 9</b>	Fluid Mechanics of Packed Bed
<b>Week 10</b>	Report discussion and assessment
<b>Week 11</b>	Sieve Analysis
<b>Week 12</b>	Report discussion and assessment
<b>Week 13</b>	Gas Solid Fluidization
<b>Week 14</b>	Report discussion and assessment
<b>Week 15</b>	Final term exam

<b>Learning and Teaching Resources</b> مصادر التعلم والتدريس		
	<b>Text</b>	<b>Available in the Library?</b>
<b>Required Texts</b>	<ul style="list-style-type: none"> <li>• Colulsson ,J.M and Richardson J.F. “Chemical Engineering , volume 1”, Fifth edition 2002, Elsevier Science, Linacre House, Jordan Hill, Oxford.</li> <li>• Colulsson ,J.M and Richardson J.F. “Chemical Engineering , volume 2”, Fifth edition 2002, Elsevier Science, Linacre House, Jordan Hill, Oxford.</li> <li>• Dutta Binary K. (2007), “Principles of Mass Transfer &amp; Separation Process”, Bvt. Ltd. Prentice Hall, ISBN 8-1203-2990-2.</li> </ul>	Yes
<b>Recommended Texts</b>	<ul style="list-style-type: none"> <li>• Treybal Robert E. (1975), “Mass transfer Operation” 2P ndP Edition, Mc-Graw-Hill Book.</li> <li>• McCabe, W., Smith, J., Harriott, P. (2004), “Unit Operations of Chemical Engineering”,Mc-Graw-Hill Co., 7P thP Edition, ISBN0072848235.</li> </ul>	Yes
<b>Websites</b>		

APPENDIX:

GRADING SCHEME مخطط الدرجات				
Group	Grade	التقدير	Marks (%)	Definition
Success Group (50 - 100)	A - Excellent	امتياز	90 – 100	Outstanding Performance
	B - Very Good	جيد جدا	80 – 89	Above average with some errors
	C –Good	جيد	70 – 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 – 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 – 59	Work meets minimum criteria
Fail Group (0 – 49)	FX – Fail	مقبول بقرار	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required
Note:				



ملاحظة: هذا النموذج تم وضعه وتقديمه من قبل مديرية ضمان الجودة في وزارة التعليم العالي والبحث العلمي