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

# MODULE DESCRIPTOR FORM
# نموذج وصف المادة الدراسية

| **Module Information**<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Mass Transfer | | | **Module Delivery** | |
| **Module Type** | CORE | | | **Lecture**<br>**Lab**<br>**Tutorial** | |
| **Module Code** | UOMU0102054 | | | | |
| **ECTS Credits** | 6 | | | | |
| **SWL (hr/sem)** | 150 | | | | |
| **Module Level** | | 3 | **Semester of Delivery** | | 1 |
| **Administering Department** | | Department of Chemical Engineering and Petroleum industries | **College** | | College of Engineering and Technology |
| **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** | | 2025/11/1 | **Version Number** | | 1.0 |

<table>
<tr><th colspan="4">Relation With Other Modules<br>العلاقة مع المواد الدراسية الأخرى</th></tr>
<tr><td>Prerequisite module</td><td>Chemical Eng. Principles III, Fluid Flow II</td><td>Semester</td><td></td></tr>
<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
<tr><th colspan="4">Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية</th></tr>
<tr><td>Module Aims<br>أهداف المادة الدراسية</td><td colspan="3">• The student should be able to understand the concept of molecular diffusion in the steady state.<br>• The student should recognize how to describe counter-diffusion processes under equimolar counter-diffusion conditions.<br>• The student should acquire the ability to calculate the time required for the liquid level to decrease in specific containers.<br>• The student should be able to estimate diffusion coefficients of various substances in liquid and gaseous phases.<br>• The student should understand the fundamental principles of Maxwell's law of diffusion in binary and multicomponent systems.<br>• The student should be capable of estimating diffusion rates in liquid and solid phases.<br>• The student should master the derivation of heat transfer rates in binary gas mixtures.<br>• The student should acquire the ability to analyze empirical correlations to determine the mass transfer coefficient.<br>• The student should understand mass transfer models according to the two-film theory.<br>• The student should be able to apply the penetration theory in gas-liquid mass transfer situations.</td></tr>
<tr><td>Module Learning Outcomes<br><br>مخرجات التعلم للمادة الدراسية</td><td colspan="3">By the end of this module, students will be able to:<br><br>• Explain the fundamental concepts, terminology, and principles of diffusion processes in gas, liquid, and solid phases.<br>• Integrate and apply process information to analyze and solve problems related to separation processes and transport analogies.<br>• Develop and implement effective solutions to separation process challenges, both independently and collaboratively.<br>• Demonstrate comprehensive and integrated knowledge of separation processes and evaluate their economic and environmental significance in chemical process industries.<br>• Operate engineering and measurement equipment to collect and interpret data supporting theoretical concepts.<br>• Design effective separation systems tailored to specific industrial problems and performance criteria.</td></tr>
<tr><td>Indicative Contents<br>المحتويات الإرشادية</td><td colspan="3">Introduction to Mass Transfer [6 hrs]<br>Basic concepts: concentration, velocity, mass and molar fluxes.<br>Diffusion in Binary Gases [15 hrs]<br>Fick's Law, equimolar and stationary diffusion.</td></tr>
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| | Diffusivity estimation and correction methods.<br>**Multicomponent Diffusion [6 hrs]**<br>Effective diffusivity and Maxwell's diffusion law.<br>**Diffusion in Liquids and Solids [9 hrs]**<br>Application of Fick's Law.<br>Diffusivity in condensed phases.<br>**Diffusion Theories [6 hrs]**<br>Film and two-film theories.<br>Mass transfer coefficients in different flow regimes.<br>**Diffusion Resistances [3 hrs]**<br>Resistance in both phases and intermediate concentration calculations. |

## Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

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| **Strategies** | 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. |

## Student Workload (SWL)
الحمل الدراسي للطالب

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|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 78 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 6 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 72 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | = 72/15 = 4.8 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 150 | | |

## Module Evaluation
تقييم المادة الدراسية

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 1 | 5% | Continuous | LO #١ and 2 |
| | **Assignments** | 4 | 5% | Continuous | LO #3, 4 and 7 |
| | **Lab.** | 1 | 10% | Continuous | LO # 6 |
| **Summative assessment** | **Midterm Exam** | 1 | 20% | 4, 8, 11 | LO #١ and 7 |
| | **Final Exam** | 3 hr | 60% | 16 | All |
| **Total assessment** | | | | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Introduction, Definition of unit operation, Introduction to diffusion. |
| **Week 2** | Steady-state ordinary molecules diffusion. |
| **Week 3** | Fick،s law of diffusion, |
| **Week 4** | Equimolar counter diffusion. |
| **Week 5** | Diffusion in conical vessel. |
| **Week 6** | Diffusivity in gases and vapours. |
| **Week 7** | Maxwell،s law of diffusion for binary system. |
| **Week 8** | Maxwell,s law of diffusion for multi-component mass transfer. |
| **Week 9** | Methods for mass transfer at fluid-fluid interface (phase boundary). |
| **Week 10** | Molecular diffusion in liquid phase, Diffusivities in liquids. |
| **Week 11** | Diffusion of (A) through multi-component stagnant layer mixture. |
| **Week 12** | Molecular diffusion in solid phase. |
| **Week 13** | Convection mass transfer for binary gas mixture. |
| **Week 14** | Methods to determine the mass transfer coefficient. |
| **Week 15** | Film – Pentration theory, Two – film theory (gas-liquid case). |

| Delivery Plan (Weekly Lab. Syllabus)<br>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 |

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| **Week 7** | Report discussion and assessment |
| **Week** 8 | Midterm exam |
| **Week 9** | Fluid Mechanics of Packed Bed |
| **Week 10** | Report discussion and assessment |
| **Week 11** | Sieve Analysis |
| **Week 12** | Report discussion and assessment |
| **Week 13** | Gas Solid Fluidization |
| **Week 14** | Report discussion and assessment |
| **Week 15** | Final term exam |

## Learning and Teaching Resources
مصادر التعلم والتدريس

| | Text | Available in the Library? |
|---|---|---|
| **Required Texts** | Colulsson ,J.M and Richardson J.F. "Chemical Engineering , volume 1", Fifth edition 2002, Elsevier Science, Linacre House, Jordan Hill, Oxford. | Yes |
| **Recommended Texts** | Colulsson ,J.M and Richardson J.F. "Chemical Engineering , volume 2", Fifth edition 2002, Elsevier Science, Linacre House, Jordan Hill, Oxford. | Yes |
| **Websites** | | |

**APPENDIX:**

| GRADING SCHEME<br>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 |
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| Note: | | | | |
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**ملاحظة: هذا النموذج تم وضعه وتقديمه من قبل مديرية ضمان الجودة في وزارة التعليم العالي والبحث العلمي**