University of Jordan
School of Engineering
Chemical Engineering Department

1. **Course number and name: (0915342) Transport Phenomena (2)**
2. **Prerequisites: Transport Phenomena I (0915341)**
3. **Class schedule:** 3 credits
    a. Time and place: Specified according to schedule of the semester
    b. Office hours: : Specified according to schedule of the semester
4. **Instructor:** Determined later
5. **Text book:**
    1. **James Welty, Charles E. Wicks Gregory L. Rorrer, Robert E. Wilson, Fundamentals of Momentum, Heat and Mass Transfer, 5th Edition, Wiley, 2014**
2. **References:**
    1. Christie John Geankoplis, Transport processes and separation process principles, 4 edition Prentice Hall; (March 15, 2003)

3. **Course information:**

Mechanisms of mass transfer. Mass transfer by molecular diffusion: Ficks Law, diffusivity in gas, liquid, and solids, differential equations of mass transfer: steady state and transient analysis. Convective Mass Transfer. The concept of mass transfer coefficient, mass transfer coefficient for different geometries: flat plate, single sphere, cylinder, and flow in pipes. Interphases mass transfer, the two films theory. Momentum, heat and mass transfer analogy.

4. **Course objectives and Outcomes:**

Objectives	Outcomes
1. Emphasize the importance of mass transfer as a basic pillar of chemical engineering and its role in several separation processes.	**[O7]** 1.1. Outline the transport phenomenon of mass transfer and its unique role in chemical engineering applications 1.2. Understand the need for separation and purification of mixtures in various kinds of chemical processes involved in treatment of raw materials, intermediate products and final products 1.3. Define the main types of driving forces and agents used separating mixtures
2. Introduce fundamentals of mass transfer essential to understand the engineering operations driven by this transport phenomenon.	**[O1, O2]** 2.1. Recognize diffusive and convective mechanisms of mass transfer and their analogy with heat and momentum transport phenomena 2.2. Understand diffusion, diffusion coefficient and driving forces of mass transfer; and use Fick's law to calculate diffusive flux 2.3. Identify convective mass transfer, mass transfer coefficient, interfacial mass transfer, and convective flux equation 2.4. Perform microscopic mass balance on simple geometries. 2.5. Use engineering correlations for estimation of diffusion and mass transfer coefficients under laminar and turbulent flow conditions.

5. Topics covered:

Content	Text book	Ref. 1	Week
Introduction ***Topics Covered:*** Introduction to Mass Transfer and Diffusion,	Ch 24	Ch 18	1
Molecular Diffusion ***Topics Covered:*** Ficks Law, diffusivity in gas, liquid and solids,	Ch 24	Ch 18	2+3
Differential equation of mass transfer ***Topics Covered:*** Differential equation of mass transfer, commonly encountered boundary conditions, steps for modeling processes involving molecular diffusion	Ch 25	Ch20	4+5
Steady state mass transfer	26	Ch 19	6+7
Unsteady state molecular diffusion	27	Ch 20	8+9
Convection Mass Transfer ***Topics Covered:*** Basic Concept, dimensional analysis of convective mass transfer, exact analysis of the laminar concentration, boundary layer, approximate analysis of the concentration boundary layer, mass-, energy-, and momentum-transfer analogies	Ch 28	Ch 21	10 +11
Convective Mass-Transfer Correlations: Mass Transfer coefficient for different geometries: single sphere, cylinder, and flow in pipe, Mass Transfer coefficient for different systems: bubble columns, packed and fluidized beds, wetted-wall columns	Ch 30	Ch 21	12+13
Mass transfer between phases	29	Ch 22	14+15
Final exams			16

6. Minimum student materials: Text book, class handouts, engineering calculator, and an access to Personal Computer with MATLAB and/or Excel.

7. Instructional methods:
Lectures, group assignments, class discussion and problem solving Projects and Assignments

8. Homework Assignments:
Assignments are due at the beginning of the class period on the specified date; late homework will NOT be accepted (i.e it will be awarded a zero). Please write only on one side of the page. Your name and ID number should be clearly written on first page. Start each problem on a new page. Clearly mark your answers in a box (Never use a red pen in your work). Staple the pages together.

9. Assessment & Grading:

Quizzes & Assignments	:	20%
Midterm Exam	:	30%
Final exam	:	50%
Total	**:**	**100%**

10. Relationship to Program Outcomes (%)

O1	O2	O3	O4	O5	O6	O7
√						

11. Relationship to Chemical Engineering Program Objectives

PEO1	PEO2	PEO3	PEO 4
√	√	√	√

12. Notes:

a. Discuss the assignments among yourselves. This is helpful to the learning process. However, direct copying of others work will NOT be allowed or tolerated and will result in a reduction of grade.

b. All cases of academic dishonesty will be handled in accordance with university policies and regulations.

c. There will be a number of unannounced quizzes during the semester. Students are expected to be ready to take a quiz any time they have a class. There will be no make-up quizzes.

d. Students are expected to attend EVERY CLASS SESSION and they are responsible for all material, announcements, schedule changes, etc., discussed in class. The university policy regarding the attendance will be strictly adhered

e. Any students with disabilities who need accommodations in this course are encouraged to speak with the instructor as soon as possible to make appropriate arrangements for these accommodations.

f. Exams are scheduled as shown in the syllabus and last 90 minutes. The exams are close textbook and notes. It is your responsibility to bring a calculator, pencils and paper. If you MUST miss one of these exams for an emergency situation, please let me know as soon as possible. If you oversleep or skip an exam you will not have an opportunity to make it up. If you have a valid (according to me) time conflict and you let me know in advance, there is the possibility of taking an exam at an alternate time.

13. ABET Criteria : Outcomes and Assessment: Engineering programs must demonstrate that their graduates have

O1 Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

O2 Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

O3 Communicate effectively with a range of audiences.

O4 Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

O5 Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

O6 Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

O7 Acquire and apply new knowledge as needed, using appropriate learning strategies.