1. **Course number and name - CHBE 3210 – Transport Phenomena II *(required)***

2. **Credits and contact hours** - 3 credit hours, 3 lecture hours (3-0-0-3)

3. **Instructor's or course coordinator's name -** Dr. Victor Breedveld

4. **Textbook, title, author, and year**
   Fundamentals of Momentum, Heat and Mass Transfer, 6th edition, J.R. Welty, G.L. Rorrer and D.G. Foster, John Wiley & Sons Inc. (2014) (5th edition also suitable)

5. **Specific course information**
   a. **Catalog Description -** Fundamental principles and applications of heat and mass transfer. The analysis of chemical engineering processes and operations involving mass transfer.
   b. **Prerequisites or co-requisites** –CHBE 3130 Chemical Engineering Thermodynamic II (grade "C" or better); CHBE 3200 Transport Phenomena I (grade "C" or better).
   c. **Required, elective, or selected elective course** (as per Table 5-1) – Required

6. **Specific goals for the course**
   a. **Specific outcomes of instruction**:
   By the end of this course, a student should be able to:
      1) Analyze situations involving convective heat transfer in external and internal flow. Both forced and natural convection processes are to be analyzed.
      2) Combine heat-transport resistances in series to obtain overall heat-transfer coefficients and apply these in a variety of design applications, including shell-and tube heatexchangers.
      3) Solve steady-state problems in counter-diffusion and uni-molal, uni-directional diffusion using Fick's first law.
      4) Understand the theoretical basis of convective heat-transfer and mass-transfer, and to use the analogies between momentum, heat, and mass-transfer to interrelate rate constants.
      5) Use individual mass transfer coefficients to obtain overall mass transfer coefficients in multi-phase systems and to apply these in a variety of design applications.
      6) Develop microscopic and macroscopic mass and energy balances, and solve them for a number of systems.
      7) Design packed-columns for simultaneous heat- and mass-transfer (i.e., cooling towers, gas absorption, distillation etc.) in terms of number and height of transfer units (NTU & HTU).

b. **Connection with Student Outcomes**

CHBE 3210							
	Student Outcomes						
Course Outcomes	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Course Outcome 1	**X**					**X**	
Course Outcome 2	**X**	**X**					
Course Outcome 3	**X**					**X**	
Course Outcome 4	**X**					**X**	
Course Outcome 5	**X**						
Course Outcome 6	**X**					**X**	
Course Outcome 7	**X**	**X**					

Student Outcomes

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(2) an ability to 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

(3) an ability to communicate effectively with a range of audiences

(4) an ability to 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

(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

7. **Brief list of topics to be covered**

a. Dimensional analysis

b. Convective heat transfer
   1) Blasius solution
   2) Boundary layer similarity
   3) Turbulence and momentum analogy

c. Heat transfer correlations
   1) Internal and external flows
   2) Empirical correlations
   3) Boiling and condensation
   4) Free convection

d. Heat Exchanger Design
   1) Overall heat transfer coefficients
   2) LMTD

e. Diffusion
   1) Molecular diffusion
   2) Knudsen and restricted diffusion
   3) Fick’s law
   4) Unimolecular diffusion and counter-diffusion

f. Differential Mass Balances
   1) Steady and pseudo-steady state mass transfer
   2) Transient diffusion

3) Mass transfer involving chemical reactions

g. Convective Mass Transport
   1) Mass transfer coefficients and correlations
   2) Analogies
   3) Simultaneous heat and mass transfer
   4) Penetration theory
   5) Interphase mass transport

h. Mass Transfer Equipment
   1) Stirred tanks
   2) Continuous contact towers
   3) Operating line equations
   4) Mass transfer capacity coefficients