MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF CHEMICAL ENGINEERING
ChE 520 - Transport Phenomena

Course Syllabus and Schedule for Fall 2017

Instructor

İsmail Tosun
Professor of Chemical Engineering
Office: D-Z06 Phone: 2637
itosun@metu.edu.tr

Teaching Assistant

Cihan Ateş
Office: C-Z02 Phone: 4388/2698
cates@metu.edu.tr

Course Objectives

The purpose of this course is to give a systematic presentation of momentum, energy, and mass transfer at microscopic and macroscopic levels in conjuction with illustrative examples and analogies.

Classroom Hours

T 09.40 (Room: Z-121) **Th** 08.40-10.30 (Room: Z-121)

Office Hours

Students are welcome (and encouraged) to come as needed. If I am in my office and not on the phone or with another person, I will make time for you. At minimum, we will arrange a time to meet that will accommodate both of our schedules.

Mr. Ateş will hold a tutorial on Wednesdays (15.40-17.30) in Room Z-16.

Course Website

The course outline, homework assignments, and all handouts will be posted on **ODTÜ-Class** (*https://odtuclass.metu.edu.tr*).

Exam Dates

Midterm Exam # 1: November 9, 2017
Midterm Exam # 2: December 21, 2017
Final Exam: To be arranged

Textbook

R.B. Bird, W.E. Stewart, E.N. Lightfoot, *Transport Phenomena*, 2^{nd} Ed., Wiley, 2002.

Recommended Textbooks

I. Tosun, *Modeling in Transport Phenomena: A Conceptual Approach*, 2^{nd} Ed., Elsevier, 2007.

W.M. Deen, *Analysis of Transport Phenomena*, 2^{nd} Ed., Oxford University Press, 2012.

Policies and Procedures

• Examinations

All tests will be open-book (BSL's original textbook) and open-notes (class handouts and your own handwritten notes, not homework solutions). It is your responsibility to understand the exam questions. If you have difficulty with English, you may bring a dictionary with you.

If you miss an exam with a certified medical excuse, you may take a make-up exam at a designated time during the final exams (Jan. 8 - 20, 2018). It will be comprehensive and **CHALLENGING**.

• Homework assignments

Students are encouraged to work in groups on homework problems, but individual solutions should be turned in by each student. You may **not** copy solutions from a classmate or from solution sets from previous years to which you might have access. Presenting someone else's work as your own is plagiarism and will be dealt accordingly. Homeworks must be submitted in class (Wednesday 10.40), one week after the assignment is distributed. Use A-4 size paper and one side of each page. Follow the format provided below:

- ▶ Problem statement
- ▶ Schematic (if possible)
- ▶ Define the system
- ▶ Physical properties (if necessary)
- ▶ List your assumptions
- ▶ Analysis (Apply the appropriate basic concepts and solve the resultant equations)
- ▶ Verify assumptions (if possible)
- ▶ Check limiting solutions (if possible)

To get an AA in this course, you must attempt and do satisfactory work on all homework problems in addition to getting the necessary weighted average grade on tests.

Late homework will be accepted up to one week after the due date and will receive a maximum grade of 60%. However, if you abuse this privilege by routinely handing in homework late, the privilege will be withdrawn.

• **Grading**

A weighted average grade will be calculated as follows:

Midterm exams	:	50% (25% each)
Homework	:	15%
Final exam	:	35%

There will be a gray area between each two letter grades in the final distribution, so that two students getting the same weighted average could get different letter grades. If you are in one of these gray areas, whether you get the higher or lower grade depends on three factors: (i) class attendance and participation in class, (ii) your performance on homework problems, (iii) whether your midterm exams and homework performance has been improving (your grade goes up) or declining (it goes down).

• **Classroom Rules and Behavior**

Attendance at every class meeting is strongly recommended. If you are one of those students with unexcused absences, do not expect me to spend time outside of the class to answer your questions related to the material covered during these absences.

Always bring your textbook (BSL) to class since I will be referring to it often.

Do not arrive late to class and do not leave the classroom during class meetings. Exceptions may occur for medical emergency or situations where prior instructor approval has been granted.

Cell phone use, including texting, is prohibited in the classroom. If an unusual family situation requires you to be available, set your phone to vibrate and sit near the exit. Cell phone use in the classroom is distracting to the professor and to nearby students, and studies have shown that students who use their phones in class learn less and obtain lower grades.

The consumption of food and drink (except water) during class meetings is prohibited.

Course Outline

Date	Topic	Homework
Oct., 3	Basic concepts	
Oct., 5	Vectors & tensors	HW # 1 (Date due: Oct., 12)
Oct., 10	Kinematics	
Oct., 12	Equations of continuity & motion	HW # 2 (Date due: Oct., 19)
Oct., 17	Fluid statics	
Oct., 19	Flow through a circular tube	HW # 3 (Date due: Oct., 26)
Oct., 24	Tangential annular flow	
Oct., 26	Non-Newtonian fluids	HW # 4 (Date due: Nov., 2)
Oct., 31	Order of magnitude (scale) analysis	
Nov., 2	Lubrication approximation	
Nov., 7	Conservation of energy	
Nov., 9	**Exam # 1**	
Nov., 14	Steady-state conduction	HW # 5 (Date due: Nov., 21)
Nov., 16	Viscous heating in Couette flow	
Nov., 21	Area averaging	HW # 6 (Date due: Nov., 28)
Nov., 23	Graetz problem	
Nov., 28	Natural (Free) convection	HW # 7 (Date due: Dec., 5)
Nov., 30	Conservation of chemical species	
Dec., 5	Diffusion through a stagnant gas	HW # 8 (Date due: Dec., 12)
Dec., 7	Diffusion through a stagnant liquid	
Dec., 12	Diffusion with homogeneous reaction	HW # 9 (Date due: Dec., 19)
Dec., 14	Diffusion & rxn inside a porous catalyst	
Dec., 19	Diffusion into a falling liquid film	
Dec., 21	**Exam # 2**	
Dec., 26	Unsteady-state applications	HW # 10 (Date due: Jan., 2)
Dec., 28	Unsteady-state applications	
Jan., 2	Macroscopic mass & momentum balances	HW # 11 (Date due: Jan., 8)
Jan., 4	Bernoulli equation	