

Chemical Engineering 356 Section B TRANSPORT PHENOMENA I

Semester: Spring 2017

Class Meetings: MWF 2:10 to 3:00, Pearson 1115

Course Description: Momentum and mechanical energy balances. Incompressible and compressible fluid flow. Applications to fluid drag, piping system design, filtration, packed beds and settling.

Learning Outcomes:

- Apply microscopic material and momentum balances
- Apply macroscopic material, mechanical energy and momentum balances
- Use dimensional analysis of balances to characterize fluid flow regimes
- Explain and apply the relationships between flow rate, pressure changes, pipe diameter and length, and fluid properties for simple and complex pipe networks and packed beds
- Solve engineering problems involving hydrostatics, Newtonian and non-Newtonian fluids, boundary layer flow, turbulent flow and drag forces on falling or submerged objects

Prerequisites: The prerequisites for this course are Ch E 205, Ch E 210, Phys 221; credit or enrollment in Math 267

Course prerequisites will be enforced according to University policy:

<http://catalog.iastate.edu/informationaboutcourses/>. This means that students who are enrolled in this course but have not met the prerequisite requirements must drop the course. The instructor will not grade any coursework submitted by a student who has not met the course prerequisites and if the student does not drop this course, the student will earn an “F” grade for this course. Students who do not meet prerequisites but do have equivalent preparation may submit a request for a prerequisite waiver to the instructor. Waivers are available on the CBE website.

Primary Instructor: Professor Nigel F. Reuel (3051 Sweeney, 294-4592, reuel@iastate.edu)

Teaching Assistant: Elspeth Petersen (elspethp@iastate.edu)

Office hours: Elspeth Petersen – Thursdays from 2:10 to 5:00PM in Beyer 2308

Dr. Reuel – Monday from 3:10 to 5:00PM in Pearson 1106,

Tuesdays from 8:00 to 9:00AM in Sweeney 3051

Required Textbook:

(D) Noel de Nevers, Fluid Mechanics for Chemical Engineers, third edition, McGraw-Hill (2005).

Recommended Textbook (Required chapters will be available through Blackboard):

(B) Bird, Stewart and Lightfoot, *Transport Phenomena*, second edition, Wiley (2007)

(M) McCabe, Smith, and Harriott, *Unit Operations of Chemical Engineering*, McGraw-Hill

Recommended Supplies

Smart phone or laptop that has access to Blackboard for unannounced quizzes

Grading:

Exam 1	20 %
Exam 2	20 %
Exam 3	20 %
Final Exam	20 %
Homework	15%
In-class quizzes	5%

Course PoliciesGroups

You will soon find in your engineering career, that most of your tasks will be completed as a group and you will have little control over who is assigned to your team. To prepare for these work experiences, we will have weekly group problems (see Homework section below). Student groups will consist of four students. We will use the CATME Team-Maker system which asks for information about schedule, commute, etc. to make effective teams (survey opens today, closes Wed, Jan 11 at midnight). If there are special needs to consider, please put them in the comments and I can override the automated groupings (e.g. if your past experiences make it impossible to work with a certain individual). Hopefully this will allow you to get to know fellow classmates and facilitate more communication in our course. Do not worry too much about detrimental effects of group work on your grade, it only accounts for 3% of your total score. The rest is up to your individual efforts.

Grading

I expect that everyone will attend and participate effectively in class. If everyone attends class, turns in the assignments, and takes the exams, there should be very few if any grades lower than C. However, based on past course metrics, failure to attend class or take exams will likely result in a D or an F for the course.

Homework

Assignments will be given once a week, and will consist of problems from the text or ones taken from other sources. There will be one group problem in each assignment, which will be more "open ended" than the others. On the day homework is due, one of the groups will orally present their solution to the class. Each group will turn in one copy of their group problem, which will be graded separately from the other problems to be turned in by each student individually. You are free to discuss all homework problems with classmates, if this helps you. However, please understand that what you learn from the problems depends on your personal contribution to the solutions.

Any questions on grading will be handled by me.

As indicated on the syllabus, homework is 15% of the grade. If you choose not to turn in assignments consistently, there are three likely outcomes: (1) Your course grade will suffer directly because most people turn in assignments. (2) You will be at a **huge** disadvantage during the exams, since the style of exam and homework problems is similar by design. (3) Most significantly, homework problems are the most important learning mechanism in this course, because they force you to think carefully about the material. **Do the homework! If you don't, you won't effectively learn and it will be hard to get a good grade.**

The homework assignments will be posted to blackboard at 5 PM on these Fridays: Jan 13, 20, and 27, Feb 3, 17, and 24, March 3, 24, and 31, April 7, and 21 [eleven problem sets total] and will be **DUE at the start of class the following Friday**. Do your work for each problem on **separate pages** so they can be turned into separate grader boxes (staple pages if one problem takes more than a page to formulate solution). Write clearly and place your name on top of each problem. We will not spend time tracking down authors to anonymous solutions.

Quizzes

Unannounced in-class quizzes will consist of one or two questions using Blackboard. Every student is required to bring a device that can access Blackboard (smartphone or laptop) to class each day. The quiz grade will be 5% of the total course grade. Each correct response will receive 2 points, and each incorrect response 1 point.

Exams

The exams will be open book. The style of exam questions will be similar to homework problems, but of course shorter. The dates of exams as listed in the syllabus will be confirmed by me two weeks in advance. If you cannot take the exam because of a medical problem or a conflict with another university-sponsored activity, please obtain my approval at least one week in advance.

Consulting

The TA and I will each hold two sections of office hours per week (see first page). **We expect to be fully occupied during this time answering your questions, so please take advantage!** If you need to see me outside of office hours, please arrange an appointment in class, or by sending an email. I will use e-mail to communicate with the class as a whole, about changes or clarifications to homework problems and other matters. Also feel free to send me a message if you have a question or concern.

General expectations

Students are expected to spend an average of at least nine hours per week preparing for class and completing assignments.

Student conduct rules

Attend class, arrive on time, and participate. With regard to graded assignments, any failures to abide by the academic honesty policy of Iowa State University will be dealt with as specified in the ISU student handbook.

COURSE OUTLINE

A continuously updated copy of this syllabus will be available on Blackboard.

Meeting/Topic/Reading	Dates	
(1) Introduction [D 1]	1/9	
(2-4) Fluid statics [D 2]	1/11 - 1/18	
(5-7) Mass balances and first law of thermodynamics [D 3-4]	1/20 - 1/25	
(8-10) Bernoulli's equation [D 5]	1/27 - 2/1	
(11-13) Fluid friction in steady one dimensional flows [D 6]	2/3 - 2/8	
(14) EXAM 1 [Chp 1-5; HW 1-4]		2/10
(15-17) Momentum balance [D 7]	2/13 - 2/17	
(18-19) Pumps, compressors and turbines [D 10]	2/20 - 2/22	
(20-21) Flow through porous media [D 11]	2/24 - 2/27	
(22) Non-Newtonian flows [D 13]	3/1	
(23) Surface forces [D 14]	3/3	
(24, 26) Two and three dimensional fluid mechanics [D 15, B 2]	3/6, 3/10	
(25) EXAM 2 [Chp 6-7, 10-11, and 13-14; HW 5-7]		3/8
SPRING BREAK - NO CLASS	3/13 - 3/17	
(27-32) Two and three dimensional fluid mechanics [D 15, B 2]	3/20 - 3/31	
(33-34) Potential flows [D 16]	4/3 - 4/5	
(35-37) Boundary layers [D 17]	4/7 - 4/12	
(38) EXAM 3 [Chp 15-18 + BSL Chp 2; HW 8-10]		4/14
(39-41) Turbulent flow [D 18]	4/17 - 4/21	
(42-44) Review + Extra content (not on exam)	4/24 - 4/28	
FINAL EXAM	5/2 (12 to 2:00 PM)	

UNIVERSITY POLICIES

Academic Dishonesty

The class will follow Iowa State University's policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office.

<http://www.dso.iastate.edu/ja/academic/misconduct.html>

Disability Accommodation

Iowa State University is committed to assuring that all educational activities are free from discrimination and harassment based on disability status. All students requesting accommodations are required to meet with staff in Student Disability Resources (SDR) to establish eligibility. A Notification Letter form will be provided to eligible students. The provision of reasonable accommodations in this course will be arranged after timely delivery of the Notification Letter to the instructor. Students are encouraged to deliver Notification Letters as early in the semester as possible. SDR, a unit in the Dean of Students Office, is located in room 1076, Student Services Building or online at www.dso.iastate.edu/dr/. Contact SDR by e-mail at disabilityresources@iastate.edu or by phone at 515-294-7220 for additional information.

Dead Week

This class follows the Iowa State University Dead Week policy as noted in section 10.6.4 of the Faculty Handbook <http://www.provost.iastate.edu/resources/faculty-handbook>.

Harassment and Discrimination

Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. Any student who has concerns about such behavior should contact his/her instructor, Student Assistance at 515-294-1020 or email dso-sas@iastate.edu, or the [Office of Equal Opportunity and Compliance](#) at 515-294-7612.

Religious Accommodation

If an academic or work requirement conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be in writing, and your instructor or supervisor will review the request. You or your instructor may also seek assistance from the [Dean of Students Office](#) or the [Office of Equal Opportunity and Compliance](#).