Course Syllabus

CM 3110: Transport/Unit Operations 1
(Fall 2019)

Instructor:
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Course Description and Timing:
Develop an understanding of the processes of momentum transfer (fluid mechanics) and heat transfer. Presents the basic equations of microscopic momentum and heat transfer, along with macroscopic transport equations that can be used in engineering analysis.

- MW 3-4:20pm Fisher 139 (enrolled 60)
- TR 3:30-4:50pm EERC 100 (enrolled 30)

Prerequisites:
PH2100, CM2120, plus math through differential equations. All the prerequisites to these classes are also prerequisites to this class.

This course will make intensive use of all of your math background (units, algebra, calculus, differential equations, vectors, partial derivatives), your physics background (Newton's laws, forces, problem solving, sig figs), and your chemical engineering background (mass and energy balances, macroscopic energy balances, heat exchanger basics, friction in flow, introductory unit operations and staged operations). For a handy sheet of commonly used integrals, see the supplemental handouts link (http://www.chem.mtu.edu/~fmorriso/cm310/2014CommonIntegrals.pdf) and the pre-requisite reading list (http://pages.mtu.edu/~fmorriso/cm310/reading_assignments.html).

The first exam is week 2 and it is on prerequisite material.

Office Hours:
Dr. Morrison's office is in 304A and her office hours are posted on the web (http://www.chem.mtu.edu/~fmorriso/office_hours.html); other times by arrangement - request by email.

TA: Mr. Utkarsh Shailesh Chaudhari, uschaudh@mtu.edu, office hours: by appointment. Sunday Evening (6:30-7:30, Chem Sci 211) homework, problems, and exam preparation discussion sessions with the TA are scheduled weekly (except for 15Sept2019).
Learning Objectives

Upon successful completion of CM3110, students will be able to

1. Readily and accurately apply steady state mass and energy balance calculations to a wide range of chemical engineering applications
2. Recognize and describe quantitatively the momentum and heat transport processes affecting a wide variety of chemical engineering processes
3. Analyze quantitatively the momentum and steady heat transfer effects in chemical engineering processes using both macroscopic and microscopic balances.
4. Effectively use dimensional analysis results in practical problem-solving of chemical engineering unit operations involving momentum transfer and steady heat transfer.
5. Readily analyze and model the performance of heat exchangers of various types.
6. Recognize and describe quantitatively radiation heat transfer effects and mechanisms in chemical engineering processes.

Textbooks and Resources

Required


Christie J. Geankoplis, Transport Processes and Unit Operations, 4th Edition, Prentice Hall, New York (2003). Available free in electronic form through the Michigan Tech Library's Safari O'Reilly's Learning Platform for Higher Education, (https://learning.oreilly.com/library/view/transport-processes-and/013101367X/?ar). You can sign in with your Tech email, and if you confirm the reply email, your account will store your highlights and notes. If you prefer to use the book anonymously, you can create a dummy account (mickeymouse@mtu.edu) which will work for a few days and then go dead, but you can create it again. You cannot save your highlights and notes when working under a pseudonym.

I strongly recommend that you print and use the unit conversion and physical property sheet I have prepared (http://pages.mtu.edu/~fmorriso/cm310/convert.pdf).

Supplemental


Perry's Handbook of Chemical Engineering, 8th Edition (McGraw-Hill Professional, New York, 2007). Note that if you join the AIChE (at the national level) you receive access to the online Perry's free. See the AIChE officers for more information.
**Additional Resources**


**Assignments and Grading System**

**Reading**

*Reading recommendations*, including on prerequisite materials, are provided on a separate handout (http://pages.mtu.edu/~fmorriso/cm310/reading_assignments.html). Readings of two types are assigned: basic and stretch. Stretch readings are provided for students who aspire to top comprehension and top class performance.

**Exams**

There will be four 1.5 hour (90 minute) evening exams plus a two-hour final exam. The exams will be closed book, closed notes with one 8.5 by 11 sheet, both sides, allowed for formulas (may be computer printed). Exams will likely include some instructor-produced handout tables and formula sheets as well. An exam may include any topic covered in the course up to the section indicated in the syllabus for that exam. Prerequisite material may appear on any of the exams.

- Exam 1 (week 2): Tuesday 10 September 2019, Dow 641, 6:30-8pm
- Exam 2 (week 5): Thursday 3 October 2019 MEEM 111&112 6:30-8pm
- Exam 3 (week 9): Thursday 31 October 2019 M&M U115 6:30-8pm
- Exam 4 (week 12): Tuesday 19 November 2019 MEEM 111&112 6:30-8pm
- Comsol Project (week 14): Friday 13 December 2019, 2pm
- Final exam (week 15): As scheduled by the registrar. The fall 2019 final exam schedule for all classes can be viewed at: http://www.mtu.edu/registrar/ at the end of the 6th week of the semester.

Students who have registered their need for accommodations with the Dean of Students (Disability Services) will be accommodated as requested. University policy requires 5-day advance notice of a request for accommodation. Note that the first exam is 8 calendar days from the first day of class; please file your accommodation paperwork before the first day of class in order to receive accommodation for the first exam.

Make-up exams will not be given except under extraordinary circumstances and when appropriate documentation is provided (medical, for example). Check the exam schedule and your final exam schedule early and report any conflicts as soon as possible.

No cell phone use or internet use of any sort allowed during exams.
Grading

1. First exam: 15% (prereq material)
2. Second exam: 20%; (lectures 1-6)
3. Third exam: 20%; (lectures 1-12)
4. Fourth exam: 20%; (lectures 1-17)
5. Comsol project: 5%
6. Final exam: 25%; (1-23)

Scale: 90-105 %A; 86-89 AB; 80-85 B; 76-79 BC; 70-75 C; 66-69 CD; 60-65 D; Less than 60% F

Homework

Homeworks are assigned. All assigned homeworks will be posted on the web. The homeworks are designed to focus your attention on the types of calculations that will improve your comprehension of the topics of this course. Answers to homeworks are provided on the website; solutions to homeworks are not provided on the website, but the TA will discuss homework solutions during Sunday sessions or by appointment at other times. You may also bring your questions to the instructor during office hours. Note that worked examples in the required and recommended texts are also opportunities to work out a problem and to compare to the published solution.

The problems on the exams are not modeled on the homework problems, but the homework problems are designed to employ the same problem-solving skills as will be needed to do well on the exam. Your aim is meant to be to develop those problem-solving skills and critical thinking skills (to learn to formulate the right questions; this guides you to solving real problems). One of these skills is to read the problem carefully and compose appropriate questions to determine how to frame the solution to the problem. Significant figures are important on anything that is submitted in this course or shared with an instructor or colleague.

You may work on homework assignments with your classmates. You may ask for homework help from the TA or from the instructor or from anyone else.

Homework problems of two types will be assigned: basic and stretch. Stretch homework problems are provided for students who aspire to top comprehension and top class performance. Your best preparation for the exams is to attend lectures, do the readings, do the homework, see the professor or TA with questions you have on the homework assignments and lectures. Starting the problem (setting it up) is typically the hardest part of a transport/unit operations modeling problem. Simply reading over solutions is not good preparation for actually carrying out a calculation yourself.

Studying

Study Groups

You are encouraged to work together in study groups to trade ideas on how to solve problems and to help to teach each other the subject. The students who have done best in my classes in the past formed a study group (4-8 students) and met regularly to work on the homework. They came to instructor office hours regularly with any questions they could not resolve themselves.
CM Learning Commons

Fall 2019 marks the debut of the Chemical Engineering Learning Commons, room 310. The coordinator for 2019-20 is Jacob LeBarre email (jplebarr@mtu.edu). The CMLC is staffed Monday through Thursday 6-8pm for the weeks that classes are in session.

Cheating

Cheating of any form will not be tolerated. All exam work must be your own; what you submit for your Comsol project must be the sole work of the person whose name appears on the submission. Submitting for credit a solution that is not your own is plagiarism and is considered cheating. If you use any solutions from the literature (the internet, a book, a friend), you must cite the source with a formal reference. Using someone else’s work without attribution is considered cheating.

Note that since homework assignments are not submitted in this class, working together on the homework is permitted and, in fact, encouraged.

Any student found to be cheating would be reported to the Dean of Students. The punishment for plagiarism ranges from an F in the course to expulsion.

University Policies

The Michigan Tech University Senate Policy states that this course syllabus must provide information on university policies, including those related to academic integrity, disability services and institutional equity. Since policies and web links to these policies could change over time, we have been encouraged to include the following web link to provide up-to-date information: http://www.mtu.edu/ctl/instructional-resources/syllabus/policies.html.

Program Assessment:

Student work products (exams, essays, projects, etc.) may be used for the purposes of university, program, or course assessment. All work used for assessment purposes will not include any individual student identification.
Educational Objectives and Student Outcomes for the Department of Chemical Engineering

Michigan Tech Chemical Engineering ABET link:
https://www.mtu.edu/chemical/undergraduate/accreditation/

Educational Objectives

Michigan Tech Chemical Engineering alumni:

1. are successful early and have sustained success in their professional careers;
2. are valued for their hands-on engineering ability and safety culture;
3. have effectively communicated their technical knowledge via publications, reports, the Internet, and other media;
4. are providing service to society;
5. are earning or have earned advanced degrees or have participated in continuing education; and
6. have achieved leadership positions in their chosen professions.

Student Outcomes for the Department of Chemical Engineering

Graduates will have the following:

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.

Program Criteria for the Department of Chemical Engineering

The curriculum provides a thorough grounding in the basic sciences including chemistry and physics, with some content at an advanced level. The curriculum includes the engineering application of these basic sciences to the design, analysis, and control of chemical and physical processes, including the hazards associated with these processes.