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CHE 3600 – Transport Phenomena II (Heat and Mass Transport)  
(Fall 2020)

Instructor:
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Graduate TA:
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Class Meeting: Monday and Wednesday 2:30-3:45pm@Zoom Virtual Class  
https://wayne-edu.zoom.us/j/94659244960?pwd=SWgvemJWeDVDc2E5Q1dMSjZIZ005UT09  
extcept in-person Exam 1, Exam 2, and Final Exam@Main 1107

Office hours:
Monday 1-2pm @ Zoom Virtual Office Hour  
Pls. make appointments by email for any meetings outside the office hours.

Syllabus

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topics/Reading assignment</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>9/2</td>
<td>Class general info; Review of basic transport mechanisms, Labor day (9/7), no class</td>
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<tr>
<td>Week 2</td>
<td>(9/7), 9/9</td>
<td>Ch 9.1-9.3. Overview of heat conduction, convection, radiation, Conductive (Molecular) energy transport</td>
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<td>Week 2</td>
<td>9/14, 9/16</td>
<td>Ch 10.1-10.3; Shell energy balance; T-distribution</td>
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<td>Week 3</td>
<td>9/21, 9/23</td>
<td>Ch 10.5-10.7 Cont’d, conduction in solids Ch 9.7 Convective energy transport</td>
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<td>Week 4</td>
<td>9/28, 9/30</td>
<td>Tutorial of shell balance and heat conduction Ch10.4-10.5 Cont’d convective energy transport</td>
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<tr>
<td>Week 5</td>
<td>10/5, 10/7</td>
<td>10.4-10.5 Conduction with viscous flow Ch 11.1-11.2 General equations for energy transfer</td>
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<td>Week 6</td>
<td>10/12, 10/14*</td>
<td>Chapter 9-10 review Exam 1</td>
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<td>Week 7</td>
<td>10/19, 10/21</td>
<td>Ch 11.4-11.5 One-dimensional heat transfer problems Ch12.1: Unsteady heat transfer</td>
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<td>Week 8</td>
<td>10/26, 10/28</td>
<td>Ch 12.4: Boundary layer and film theories Ch 14.1: Convective heat transfer</td>
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<td>Week 9</td>
<td>11/2, 11/4</td>
<td>Ch 14.1-14.2 heat transfer coefficient</td>
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<td>Week 10</td>
<td>11/9, 11/11</td>
<td>Ch14.3-14.5 Forced convective heat transfer Ch 17.1 Introduction of mass transfer</td>
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<td>Week 11</td>
<td>11/16, 11/18*</td>
<td>Chapter 11-14 review Exam 2</td>
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Week 12 11/23, (11/25) Ch.17.1-17.2 Diffusive mass transfer  
*Thanksgiving break (11/25), no class*

Week 13 11/30, 12/2 Ch 18.1-18.2 Concentration distribution  
Ch.18.3-18.5 diffusion within catalyst pellets

Week 14 12/7, 12/9 Ch17.7-17.8. Convective mass transport, j-factor

Week 15 12/14, 12/16 *Transport II review*  
*Final exam*

**Textbook:** *Introductory Transport Phenomena*  
*by* R. B. Bird, W. E. Stewart, E. N. Lightfoot and D. J. Klingenberg (BSL)

**Reference books:**  

**Course Description:** Thermodynamics tells us if a transformation or process can be expected to occur. Transport phenomena, often tells us how fast it will occur. Last semester, momentum transfer was the primary topic. This semester the topic will be heat and mass transfer. Generally, the focus will begin with the fundamental equations of transport on the microscale (with large continua of molecules, but smaller than any geometric scale of the system), which are then integrated mathematics of the solution procedures. Considerable effort will be spent on developing a strong understanding of transport processes so that the ideas can be applied to the many different systems that students will encounter, when they are no long students.

**Learning Objectives:**  
Students who complete this course should be able to:  
a. Understand the molecular origin of heat conduction and mass diffusion.  
b. Understand the meaning of the various terms of the differential and integral equations for heat and mass transfer.  
c. Be able to solve one-dimensional and selected two-dimensional heat and mass transfer problems in finite and semi-infinite domains and understand associated mathematics.  
d. Be able to obtain heat and mass transfer valid coefficients for simple and complex systems and understand how to get overall interphase transport rates and also how this topic is related to boundary-layer theory.  
e. Have attained a good understanding of scaling analysis and how it can be used to compare the quantitative importance of relative effects and how scaling is related to dimensional analysis and non-dimensional groups.

**Course Grading Policy:**  
Homework: 20%  
Hour Exams (*10/4, 11/18 in person*): 45% (22.5% each)  
Final Exam (*Dec 16, 2:45-4:45pm*): 35%

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Homework:
HW is usually assigned bi-weekly with a group of problems, due by 7 pm Monday or Wednesday mostly. ~ 7 total homework assignments. HWs and solutions are posted @Canvas.

A Few Simple Rules
1. Neat homework and on-line Canvas submission: Homework problem sets must be done neatly and conform to good engineering practices. Problem sets must be done on one side only of 8.5”×11” sheets of paper with no frayed edges. Multiple pages must be stapled. You should briefly restate the problem, identifying known and unknown quantities, provide a diagram if appropriate, and clearly state the key assumptions. Your analysis should be clear, underline key intermediate results, and box the final answer. If a homework assignment does not meet these quality and formatting standards, a grade of zero point will be earned for that assignment. When appropriate comment on your final answer. For example, does it seem reasonable? Can you make generalizations based on the result? The guidelines for neat homework are also applied to hour exams and final exam.

For online HW submission via Canvas, please submit one pdf file including all the HW pages. NO jpeg or other image files will be accepted! (Please find and download a scanner or image-pdf conversion app.)

2. The exams will be cumulative and administered in class. All the exams will be closed book and closed notes. Needed appendix and graphs will be given for the exams.

3. Make-up exam policy: As two hour-exams take place during the regular lecture time, NO make-up exams will be granted unless your absence is due to (1) attending some events to represent the University or College of Engineering or Department of Chemical Engineering or (2) sickness. For case (1), I require an email from the student or representing organizations at least 5 days before the exam date. For case (2), I request an email from the student as soon as he/she considers to miss the exam and a doctor’s diagnostic note with doctor visiting date, office phone number and doctor’s signature. *Under the current COVID-19 situation, you can be granted to take exam online via Zoom on the same date of in-person exam if you report a positive COVID-19 test result as early as 10 days before the exam date. Note: Make-up exam taken after the exam date will be different from the scheduled one, for which I don’t particularly control the difficulty level or expected target average.

Late homework.
Late work is not accepted, unless prior arrangement is made with the course instructor. In this case, “prior” means at least 24 hours before the due date. Each student is allowed for at most ONE pre-arranged delayed homework submission without penalty. For any late HW submission beyond each student’s one allowed, 20 points out of 100-point HW will be deducted.

Attendance Policy.
Attendance in class/virtual Zoom class is encouraged. If you decide to attend, please arrive promptly, attentive, and ready to work.

Regrade Policy.
Mistakes can be made during grading. Re-grading to correct these mistakes will be considered

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for 48 hours after the assignment or exam has been returned in class. Please submit these requests in writing. The written request should highlight: 1) the location of the suspected grading error and 2) the reason you believe a grading error exists. Note: Entire homework assignment or exam will be regarded not just the specific ones.

**Academic Integrity.**

This class runs on the premise that there is the Student Code of Conduct at Wayne State University. Conduct (http://www.doso.wayne.edu/student-conduct-services.html). All forms of academic misbehavior are prohibited at Wayne State University. The graded work you do in this class must be your own. Students who commit or assist in committing dishonest acts are subject to downgrading (to a failing grade for the test, paper, or other course-related activity in question, or for the entire course) and/or additional sanctions as described in the Student Code of Conduct.

*Cheating:* Intentionally using or attempting to use, or intentionally providing or attempting to provide, unauthorized materials, information or assistance in any academic exercise. Examples include but are not limited to: (a) copying from another student’s test paper; (b) allowing another student to copy from a test paper; (c) using unauthorized material during an exam.

*Fabrication:* Intentional and unauthorized falsification of any information or citation. Examples include: (a) citation of information not taken from the source indicated; (b) listing sources in a bibliography not used in a research paper.

*Plagiarism:* To take and use another’s words or ideas as one’s own. Examples include: (a) failure to use appropriate referencing when using the words or ideas of other persons; (b) altering the language, paraphrasing, omitting, rearranging, or forming new combinations of words in an attempt to make the thoughts of another appear as your own.

*Other forms of academic misbehavior* include, but are not limited to: (a) unauthorized use of resources, or any attempt to limit another student’s access to educational resources, or any attempt to alter equipment so as to lead to an incorrect answer for subsequent users; (b) enlisting the assistance of a substitute in the taking of examinations; (c) violating course rules as defined in the course syllabus or other written information provided to the student; (d) selling, buying or stealing all or part of an un-administered test or answers to the test; (e) changing or altering a grade on a test or other academic grade records.

**Miscellaneous**

*Course Drops and Withdrawals:* In the first two weeks of the (full) term, students can drop this class and receive 100% tuition and course fee cancellation. After the end of the second week there is no tuition or fee cancellation. Students who wish to withdraw from the class can initiate a withdrawal request on Pipeline. You will receive a transcript notation of WP (passing), WF (failing), or WN (no graded work) at the time of withdrawal. No withdrawals can be initiated after the end of the tenth week. Students enrolled in the 10th week and beyond will receive a grade. Because withdrawing from courses may have negative academic and financial consequences, students considering course withdrawal should make sure they fully understand all the consequences before taking this step. More information on this can be found at: http://reg.wayne.edu/pdf-policies/students.pdf

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**Student Disabilities Services**: If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located in the Undergraduate Library. The SDS telephone number is 313-577-1851 or 313-202-4216.

Students who are registered with Student Disability Services and who are eligible for alternate testing accommodations such as extended test time and/or a distraction-reduced environment should present the required test permit to the professor at least one week in advance of the exam. Federal law requires that a student registered with SDS is entitled to the reasonable accommodations specified in the student’s accommodation letter, which might include allowing the student to take the final exam on a day different than the rest of the class.

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