

Elementary Transport Phenomena

ECH 3264 Class Number: 26599

Class Periods: M,W,F | Period 4 (10:40 AM - 11:30 AM)

Location: Online (100%)

Academic Term: Spring 2021

Instructor:

Dr. Sergey Vasenkov

Professor

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Grader:

TBA

University of Florida, Chemical Engineering Department

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Course Description

The main goal is to introduce microscopic analysis of energy, momentum and mass transport. Students will learn how to describe changes of energy, momentum and mass within a small region of systems which are relevant for chemical engineering applications. Students will become proficient in making simplifying assumptions, developing mathematical description of transport problems, and finding relationship between different parameters describing transport.

ZOOM will be used for live lectures and office hours. Lecture notes and recorded live lectures will be made available to all students in the class. It is important to note that lecture notes for each class meeting (for the exception of review lectures before the exams) will be published on Canvas at least 1 day before class so that students can get familiar with the material and develop questions for a discussion in class.

Our class meetings will be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and ask your questions during regular office hours, which will not be recorded. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited. The recorded lectures will be made available ONLY to students enrolled in class and teaching/grading team to facilitate student participation in class meetings.

Course Pre-Requisites

ECH 3023, MAP 2302, and MAC 2313.

Energy Transfer Operations, ECH 3223

Dr. Sergey Vasenkov, Fall 2021

Course Objectives

1. Derive differential equations from basic conservation principles describing heat, mass, and momentum transport
2. Define and utilize Fourier's law and Fick's law
3. Define the characteristics of Newtonian and non-Newtonian fluids
4. Define and explain origin of the quantities (such as heat transfer coefficient, viscosity, and diffusivity) used to describe heat, momentum, and mass transport
5. Use the equations of change to formulate differential equations with proper boundary conditions to describe transport phenomena
6. Solve one-dimensional steady problems of mass, momentum, and heat transport with and without source terms
7. Solve selected multi-dimensional problems of mass, momentum, and heat transport with and without source terms

Professional Component (ABET):

Course objectives (1)-(7) are linked to student outcome 1.

Relation to Program Outcomes (ABET):

Outcome	Coverage
1. identify, formulate and solve complex engineering problems by applying principles of engineering, science, and mathematics	High

Required Textbook

R. B. Bird, W. E. Stewart, E. N. Lightfoot, Transport Phenomena, 2nd Edition, Wiley, 2002
ISBN: 0-470-11539-4

You can download a free copy from

https://www.academia.edu/37707900/Transport_Phenomena_Bird_Stewart_Lightfoot_Second_Edition_pdf

Tentative Course Schedule

- Week 1: Review of selected types of ordinary differential equations and of vector analysis / pages 852, 853, 856, 857, 807-814, 819-822, 825-827
- Week 2: Review of selected types of ordinary differential equations and of vector analysis / pages 852, 853, 856, 857, 807-814, 819-822, 825-827
- Week 3: Thermal conductivity and Fourier's law; temperature distributions determined by shell balances / pages 266-270, 291, 292
- Week 4: Examples of energy transport problems / pages 292-298, 303-310
- Week 5: Introduction to tensor analysis / pages 815-818, 821
- Week 6: Viscosity and Newton's law / pages 11-21
- Week 7: Convective momentum transport; velocity distributions determined by shell balances / pages 34-37, 41, 42
- Week 8: Examples of multi-dimensional momentum transport / pages 42-58
- Week 9: General momentum and mass balances with examples; Newtonian and non-Newtonian fluids / pages 77-80, 83-89, 97-98, 240-243
- Week 10: General momentum and mass balances with examples; Newtonian and non-Newtonian fluids / pages 77-80, 83-89, 97-98, 240-243
- Week 11: Diffusivity and Fick's first law; transport by convection / pages 514-519, 533-537

- Week 12: Concentration distributions determined by shell balances; examples of mass transport; Fick's second law / pages 543-545, 545-560, 585
- Week 13: Concentration distributions determined by shell balances; examples of mass transport; Fick's second law / pages 543-545, 545-560, 585
- Week 14: Introduction to unsteady energy and momentum transport / pages 114-121, 374-378
- Week 15: Heat conduction with a viscous heat source / pages 283-286, 298-300

Attendance Policy, Class Expectations, and Make-Up Policy

Class attendance is strongly recommended. Excused absences are consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation. Requests for make-up tests will be granted only if appropriate documentation about illness, family emergency or UF-related travel are given to the Instructor.

Exams and Quizzes: There will be 2 exams during the semester and a final exam on the last day of classes. The exams are scheduled for TBA. The final exam is scheduled for 4/29/2021 between 12:30 PM and 2:45 PM (including time for uploading your work). There will be 4-5 announced quizzes during the semester. Quizzes will be announced at least 1 week in advance. No credit will be given for problems that have a solution but all the work leading to this solution is not shown. Partial credit will be assigned based on the rules that will be consistently applied to all students.

For all quizzes in this class the following rules will be applied: During a quiz you can use the textbook for this class. However, you cannot use homework solutions, lecture notes or any other materials.

For all exams in this class the following rules will be applied: For each exam you can prepare one page with the expressions of your choice. You can use both sides of the page. No other materials are allowed, except for the handouts given by the Instructor for the exam (if any).

- Homework:**
1. Homework will be assigned approximately once a week.
 2. Solutions will be posted on the course website.
 3. The homework must be submitted before the beginning of class on the due date.
 4. Late homework will be accepted only with instructor approval. As a rule, there will be a 20% penalty for each day it is late. No late homework accepted after the solutions are posted.
 5. No credit will be given for problems that have a solution but all the work leading to this solution is not shown.
 6. The following format has to be used:
 - a. The student's name should be written on the front page.
 - b. Begin each problem on a new page.
 - c. Underline all intermediate answers. Box all final answers.

Evaluation of Grades

Assignment	Total Points	Contribution to Final Grade
Homework Sets (10-13) (at least one set will require using Python)	10 each	10%*
Quizzes (4-5)	10 each	30%*
Exam 1	10	20%
Exam 2	10	20%
Final Exam	10	20%
Total		100%

* When calculating the total score for all quizzes and its contribution to the final grade the score of one quiz, which represents the lowest quiz score for any particular student, will be removed and not taken into account. It is expected that each student will have the total score larger than 50% for all homework assignments during the semester. Similarly, the total score larger than 35% is expected for all quizzes during the semester. A failing grade will be assigned to students if the total score for all homework assignments and/or the total score for all quizzes are smaller than 50% and 35%, respectively. In each homework assignment only one randomly selected problem will be graded. Instructor will make the problem selection. The assignment(s) requiring the use of Python will contribute 20% to the total homework credit, while the assignments requiring analytical solutions will contribute the remaining 80%.

Grading Policy

The grades will not be curved.

Percent	Grade
100 - 90	A
89.9 - 85.0	A-
84.9 - 80.0	B+
79.9 - 75.0	B
74.9 - 70.0	B-
69.9 - 65.0	C+
64.9 - 58.0	C
57.9 - 50.0	C-
49.9 - 45.0	D+
44.9 - 40.0	D
39.9 - 35.0	D-
34.9 - 0	E

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.

