

Elementary Transport Phenomena

ECH 3264 Class Number: 12073

Class Periods: M,W,F | Period 3 (9:35 AM - 10:25 AM)

Location: CHE 0237

Academic Term: Fall 2022

Instructor:

Dr. Sergey Vasenkov

Professor

University of Florida, Chemical Engineering Department

423 ChE Bldg.

[Email: svasenkov@che.ufl.edu](mailto:svasenkov@che.ufl.edu)

Phone: 352-392-0315

Office Hours: each Wednesday between 6:00 and 7:00 pm and each Thursday between 4:00 and 5:00 pm in CHE 423

Grader:

Mr. Lakshay K. Dhamania

University of Florida, Chemical Engineering Department

Email: lakshaydhamania@ufl.edu

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. The class meetings will be held in a designated classroom. ZOOM will be used for office hours.

Course Pre-Requisites

ECH 3023, MAP 2302, and MAC 2313.

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 steady problems of mass, momentum, and heat transport with and without source terms
8. Solve selected non-steady state heat transport problem(s)
9. Introduce and solve an example related to non-Newtonian flows

Relation to Program Outcomes (ABET):

Outcome	Coverage*
---------	-----------

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
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	Low
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	Medium

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Textbook

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

Tentative Course Schedule

Week 1: Review of selected types of ordinary differential equations / pages 852, 853, 856, 857
Week 2: Thermal conductivity and Fourier's law; temperature distributions determined by shell balances / pages 266-270, 291, 292
Week 3: Examples of energy transport problems / pages 292-298, 303-310
Week 4: Examples of energy transport problems / pages 292-298, 303-310
Week 5: Introduction to vector and tensor analysis / pages 807-822, 825-827
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; / pages 77-80, 83-89, 95-96.
Week 10: General momentum and mass balances with examples; / pages 77-80, 83-89, 95-96.
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 transport / pages 374-378

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 12/15/2022 between 7:30 AM and 9:30 AM. There will be 3-4 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)	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 who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.ua.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.ua.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

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://sccr.dso.ufl.edu/process/student-conduct-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.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

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: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another

and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

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

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

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 Connections Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.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://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/state-authorization-status/#student-complaint>.