

Energy Transfer Operations

ECH 3223 Class Number: 12221

Class Periods: M,W,F | Period 9 (4:05 PM - 4:55 PM)

Location: LIT 0113

Academic Term: Fall 2021

Instructor:

Dr. Sergey Vasenkov

Professor

University of Florida, Chemical Engineering Department

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Office Hours: each Wednesday between TBA

and each Thursday between TBA

Supervised Teaching (ST) student:

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University of Florida, Chemical Engineering Department

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Office hours: each Thursday between TBA

Grader:

TBA

Course Description

Steady state conduction in solids and heterogeneous materials, transient conduction, convection heat transfer, design of heat-transfer equipment and heat exchanges.

At this point it is planned that we will have face-to-face class meetings in the assigned classroom throughout the Fall semester. Detailed lecture notes 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 have an option to get familiar with the material and develop questions for a discussion in class. Lecture notes are expected to be used by students who missed class meetings. The notes can be further discussed during office hours held by the Instructor biweekly. ZOOM will be used for all office hours.

COVID-19

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the UF Health Screen, Test & Protect website for more information.

- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

Course Pre-Requisites

COT 3502 and ECH 3264

Course Objectives

- (1) Knowledge of the basics of heat transfer including Newton's law of cooling, Fourier's law, and concepts concerning heat transfer coefficients and dimensionless numbers
- (2) Derivation of a mathematical description of heat transfer problems using shell balances in Cartesian, cylindrical, and spherical coordinates
- (3) Be able to solve unsteady and multi-dimensional heat transfer problems using the knowledge of the equations of change and knowing how to perform separation of variables and/or similarity transformations
- (4) Learn how to design heat exchanger networks and evaporators

Professional Component (ABET):

Course objectives (1), (2) and (3) are linked to program outcome 1. Course objectives (4) is linked to program outcome 2. Course objectives (3) and (4) are linked to program outcome 7.

Assessed 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 | High |
| 7. Self-learning | Medium |

Required Textbook

T.L. Bergman, A.S. Lavine, F.P. Incropera, and D.P. DeWitt
Fundamentals of Heat and Mass Transfer
7th Edition, John Wiley & Sons, 2011
ISBN : 978-0-470-50197-9

Tentative Course Schedule

- Week 1: General heat diffusion equation and boundary conditions / pages 82-91
- Week 2: General heat diffusion equation and boundary conditions / pages 82-91
- Week 3: Thermal resistance / pages 112-119 and 136-143
- Week 4: Fins / pages 156-161
- Week 5: Fins / pages 156-161
- Week 6: Two dimensional steady-state conduction (analytical approach) / pages 230-235
- Week 7: Two dimensional steady-state conduction (finite-difference method) / pages 241-250
- Week 8: Two dimensional steady-state conduction (finite-difference method) / pages 241-250
- Week 9: Transient heat conduction (lumped capacitance method) / pages 280-290
- Week 10: Transient heat conduction (exact solutions) / pages 298-320
- Week 11: Transient heat conduction (exact solutions) / pages 298-320
- Week 12: Introduction to convection / pages 378-401 and 407-409
- Week 13: Internal flows / pages 518-539

- Week 14: Condensation on a vertical plate / pages 675-679
- Week 15: Heat exchangers / pages 711-714 and 722-732
- Week 16: Heat exchangers / pages 733-746

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. The midterm exams are scheduled for TBA. 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 turned in at 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. Write only on one side of a page.
 - d. All pages must be stapled.
 - e. 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 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 Conduct 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. 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 Resource 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: <http://www.distance.ufl.edu/student-complaint-process>.