

## Energy Transfer Operations

ECH 3223 Section 4221

**Class Periods:** Monday / Wednesday /Friday, Period 3 (9:35 – 10:25 am)

**Location:** NEB0202

**Academic Term:** Fall 2022

### **Instructor:**

Prof. Charles Hages

[c.hages@ufl.edu](mailto:c.hages@ufl.edu)

352-294-7002

Office Hours: Tuesday & Thursday 12:45 – 1:45 PM, ChE 417

### **Teaching Assistant/Peer Mentor/Supervised Teaching Student:**

N/A

### **Course Description**

Steady state conduction in solids and heterogeneous materials, transient conduction, convection heat transfer, heat transfer during boiling and condensation, radiation heat transfer, design of heat-transfer equipment and heat exchange networks.

### **Course Pre-Requisites / Co-Requisites**

All students should have successfully passed Computer Model Formulation (COT 3502) and Elementary Transport Phenomena (ECH 3264).

### **Course Objectives**

Upon completion of this course the student will be able to:

1. Explain the basics of heat transfer including Newton's law of cooling, Fourier's law, and concepts concerning heat transfer coefficients and dimensionless numbers
2. Derive 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; know how to perform separation of variables and/or similarity transformations
4. Learn how to design heat exchanger networks and evaporators

### **Materials and Supply Fees**

N/A

### **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	Assessed
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	Assessed
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	

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

### Required Textbooks and Software

- *Fundamentals of Heat and Mass Transfer*, 8th ed., by Bergman, and Lavine, WILEY. ISBN 9781119320425.

Note: The material is essentially the same in the 7<sup>th</sup> edition if you happen to use that edition. However, the book problems are different. I will load a guide to link the recommended problems from the 8<sup>th</sup> edition to the corresponding problems in the 7<sup>th</sup> edition, however not all problems can be found in the 7<sup>th</sup> edition. Use at your own discretion.

- Python. Can be installed for free using the Anaconda package: <https://www.anaconda.com/products/individual>

### Recommended Materials

N/A

### Course Schedule

The course will proceed according to the following *tentative* schedule; this is provided to give a rough timeline for the course and corresponding chapters in the textbook. Updates will be posted on Canvas.

Week 1: Intro / General heat diffusion equation	(Chapters 1 & 2)
Week 2: General heat diffusion equation & boundary conditions	(Chapters 1 & 2)
Week 3: 1D steady-state heat diffusion / Thermal resistance	(Chapter 3)
Week 4: Fins	(Chapter 3)
Week 5: Fins	(Chapter 3)
Week 6: Transient conduction	(Chapter 5)
Week 7: Transient conduction	(Chapter 5)
Week 8: Transient conduction / 2D steady-state conduction	(Chapter 5 & 4)
Week 9: 2D steady-state conduction	(Chapter 4)
Week 10: 2D steady-state conduction	(Chapter 4)
Week 11: Convection	(Chapters 6)
Week 12: External Flow	(Chapters 7)
Week 13: Internal Flow	(Chapter 8)
Week 14: Heat Exchangers	(Chapter 11)
Week 15: Heat Exchangers	(Chapter 11)

As determined by the registrar, the final exam for this course will be on 12/15/2022 @ 7:30 – 9:30 AM

### **Attendance Policy, Class Expectations, and Make-Up Policy**

- Attendance of lectures is highly recommended, though not required.
- Homework assignments are due via file uploads on Canvas before the start of lecture on the day they are due. As we will often go over homework problems in class, late homework cannot be accepted. Please work on assignments well in advance – don't wait until the last minute!
  - Note: The lowest homework grade will be dropped – therefore, if you are late for one of the assignments it won't hurt your homework grade.
- Dates and format for exams 1 and 2 will be announced at least 2 weeks in advance. The final exam is scheduled by the registrar - I am unable to change this.
- Requests for make-up exams will be considered only for those students who missed due to an acceptable reason as listed in the undergraduate catalog (link below). For all planned or unplanned absences, the student should inform the instructor as soon as possible according to the guidelines in the undergraduate catalog (link below).
- Students arriving late for an exam will be given only the balance of time remaining to complete their work unless an acceptable reason (see above) is provided.
- Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies: <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

### **Evaluation of Grades**

<b>Assignment</b>	<b>Percentage of Final Grade</b>
Homework*	15%
Exam 1**	25%
Exam 2**	25%
Final Exam**	35%

\* Only one problem on each homework will be graded, chosen at random. The lowest homework grade will be dropped.

\*\* All assessments are cumulative.

### **Grading Policy**

The grading scale for the course will be as follows:

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
90-100	A	4.00
85-89.9	A-	3.67
80-84.9	B+	3.33
75-79.9	B	3.00
70-74.9	B-	2.67
65-69.9	C+	2.33
60-64.9	C	2.00
55-59.9	C-	1.67
50-54.9	D+	1.33
45-49.9	D	1.00
40-44.9	D-	0.67
0-39.9	E	0.00

Instructor may lower the threshold for attaining the letter grades specified above (to the benefit of the students).

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.aa.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.aa.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](mailto:jpennacc@ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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](mailto: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](mailto: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>.