Course Syllabus for ECH 3223, Spring 2024

Course Title: Energy Transfer Operations.

Content: 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.

Prerequisites: COT 3502 and ECH 3264.

Class Meetings:
- MWF 10:40 - 11:30 pm
- PSY 151

The class website on e-learning will be used to post homework assignments/solutions as well as provide information/announcements.

Instructor:
Jason E. Butler
Professor of Chemical Engineering
431 Chemical Engineering Bldg. (CHE)
e-mail: butler@che.ufl.edu
Office hours TR 1-2 pm, or by appointment

Textbook:
- F.P. Incropera, D.P. DeWitt, T.L. Bergman & A.S. Lavine
  Fundamentals of Heat and Mass Transfer
  6-8th Edition, John Wiley & Sons
- *You must have a hard copy of this book*, as some quizzes and exams will be open book and you will not be allowed to use an online version. Unfortunately a new copy of this book is expensive, but you can get by with an older edition or perhaps find an international edition for much less.
- *Note that you may not make notes in the book, as that will be considered a violation of the honor code!* You may only highlight and/or underline critical passages and mark pages for quick access.

Other Useful Texts:
- Bird, Stewart, and Lightfoot
  Transport Phenomena
  McGraw-Hill, 1960
- Welty, Wicks, and Wilson
  Fundamentals of Momentum, Heat, and Mass Transfer
  Wiley, 1984

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Grading Criteria:

10% Computational Projects/Homework
15% First quarter quiz (1 hour, in-class, week of Feb 5th)
30% Midterm assessment (2 hour, evening, week of March 4th)
15% Third quarter quiz (1 hour, in-class, week of April 8th)
30% Final assessment (7:30 am to 9:30 am, Thursday May 2nd)
All exam dates, save the final, are *tentative*.

Grading Scale:

These percentages will earn you a letter grade of *at least*
$\geq 78\%$ - A- $\geq 68\%$ - B $\geq 58\%$ - C
Note that a score of C or better required before continuing in the ChE program: A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. More information on UF grading policy may be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Homework:

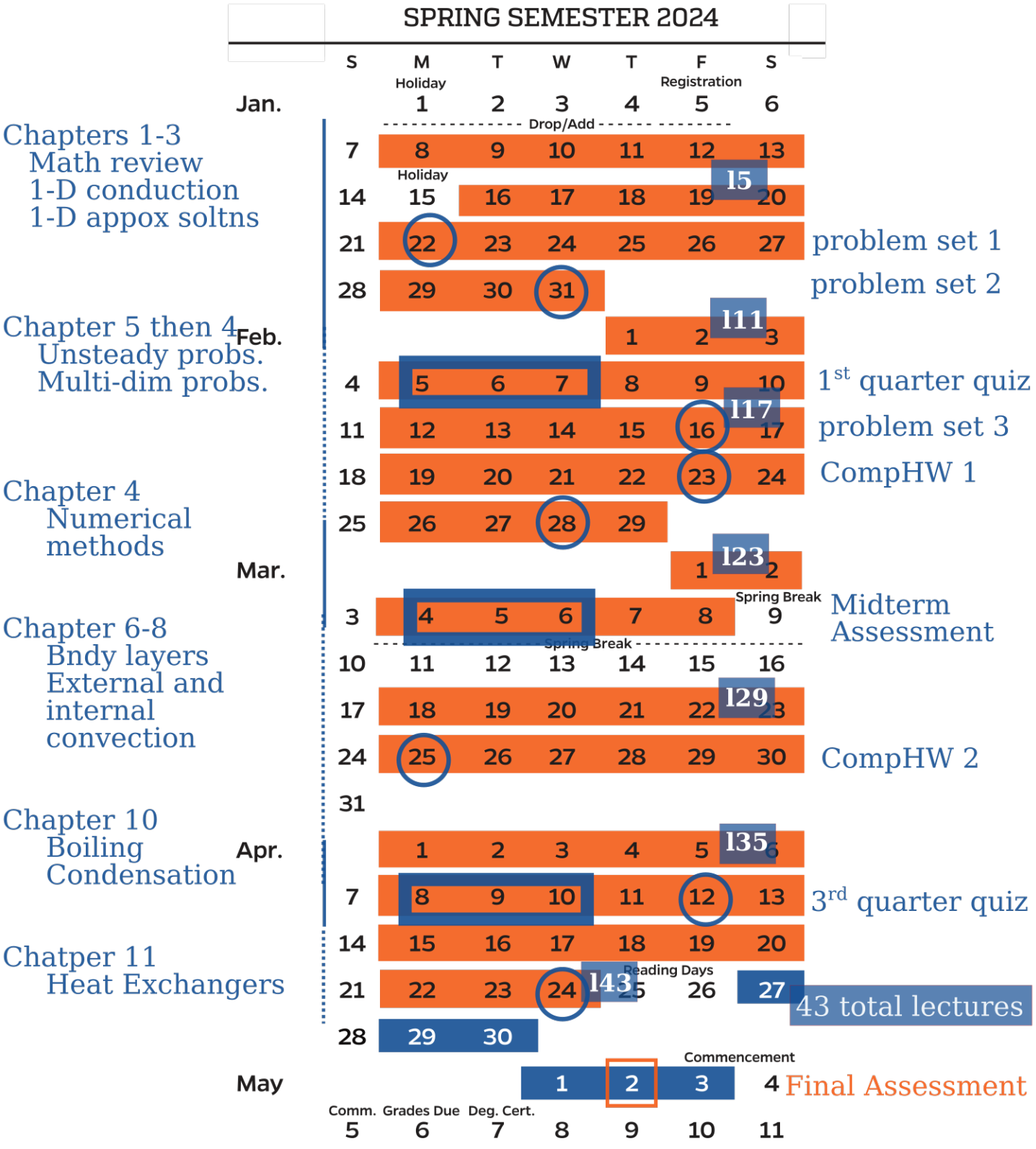
- Only *computational homework* will be graded and counted in the class score, while general homework will not be collected or graded.
- Suggested homework problems will be assigned on a 1-2 week basis with a *completion date*. Prior to the completion date, solutions will be posted on the class website.

Grading:

- Award of partial credit on individual questions will be made on a basis specified by the instructor and will be consistently applied.
- Graders will attempt to assess the value of all work accurately; however, you should present solutions that are neat and well thought-out to maximize your grade.
- Meeting the percentages listed above guarantees the specified letter grade at least.
- Instructor may employ a curve only to lower the threshold for attaining the letter grades specified above.
- The percentages for obtaining grades not listed (A, B+, etc.) above will be set by a curve.

Attendance

Students are strongly encouraged to attend all lectures, though attendance is not required. Exams/quizzes will be rescheduled only for those students who missed due to an acceptable reason (illness, serious family emergencies, military obligation, religious holidays, and participation in official university activities) as listed in the undergraduate catalog (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx). Students arriving late for a quiz/exam will be given only the balance of time remaining to complete their work unless an acceptable reason (see above) is provided.


SPRING SEMESTER 2024
S M T W T F S
Holiday
Registration
Jan.
1 2 3 4 5 6
Drop/Add
7 8 9 10 11 12 13
Holiday
14 15 16 17 18 19 20
21 22 23 24 25 26 27
28 29 30 31
Feb.
1 2 3
4 5 6 7 8 9 10
11 12 13 14 15 16 17
18 19 20 21 22 23 24
25 26 27 28 29
Mar.
1 2
3 4 5 6 7 8 9
Spring Break
Spring Break
10 11 12 13 14 15 16
17 18 19 20 21 22 23
24 25 26 27 28 29 30
31
Apr.
1 2 3 4 5 6
7 8 9 10 11 12 13
14 15 16 17 18 19 20
21 22 23 24 25 26 27
Reading Days
28 29 30
May
1 2 3 4
Commencement
Comm. Grades Due Deg. Cert.
5 6 7 8 9 10 11
l5
l11
l17
l23
l29
l35
l43
Chapters 1-3
Math review
1-D conduction
1-D appox soltns
problem set 1
problem set 2
Chapter 5 then 4
Unsteady probs.
Multi-dim probs.
1st quarter quiz
problem set 3
CompHW 1
Chapter 4
Numerical methods
Midterm Assessment
Chapter 6-8
Bndy layers
External and internal convection
CompHW 2
Chapter 10
Boiling
Condensation
3rd quarter quiz
Chatper 11
Heat Exchangers
43 total lectures
Final Assessment

Teaching Objectives for ECH 3223, Spring 2024

At the completion of this course, you will be able to:

- Derive differential equations for heat transfer from basic conservation principles in Cartesian, cylindrical, and spherical coordinates.
- Define and use the constitutive equations for heat transfer.
- Define and use concepts concerning heat transfer coefficients.
- Solve one-dimensional heat transfer problems involving conduction, convection, and radiation mechanisms.
- Use the equations of change to formulate the differential equations and boundary conditions corresponding to problems with more than one independent variable.
- Solve unsteady and multi-dimensional problems of heat transfer using separation of variables and/or similarity transformations.
- Be able to solve open-ended problems, including formulation of problem objectives, identification and estimation of critical missing information, and evaluation of possible alternatives on a technically justifiable basis.
- Apply appropriate fundamental understanding to design of heat exchanger networks.
- Apply appropriate fundamental understanding to design of evaporators.
- Understand the applications of heat transfer operations.
- Report engineering calculations and problem solutions in a professional manner.

Specific topics covered will include:

- Conduction, convection, and radiation of heat.
- Dimensionless numbers (Nusselt, Prandtl, Reynolds, Peclet, and Grashof numbers).
- Heat transfer coefficients, overall heat transfer coefficients, Newton's law of cooling, and Fourier's law.
- Shell balances in simple geometries.
- Generalized equations of energy.
- Graphical methods for transient conduction of heat in solids in one and three dimensions.
- Solution of partial differential equations for transient heat transfer by conduction.
- Heat transfer coefficient correlations.
- Shell and Tube Heat Exchangers, Flow and temperature distributions in complex geometries (e.g., 1-2, 2-4 exchangers), Heat transfer coefficients (shell and tube sides), Correction of log-mean temperature driving force for cross-flow, Heating effectiveness.
- Considerations for selection of heat exchangers.
- Transport Analogies (Reynolds, Chilton-Colburn J-Factor).
- Evaporation, Processing Factors, Types of Evaporators Single and Multiple effect, Overall Heat-Transfer Coefficients, Calculation Methods for Single Effect Evaporators Effects of Processing Variables, Boiling Point Rise Enthalpy Concentration Charts.

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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 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.