

Heat Transfer

EML4140 Section 5964

Class Periods: M, W, F Period 8 (3:00 pm – 3:50 pm)

Location: TURL011

Academic Term: Spring 2024

Instructor:

Youngsup Song

youngsupsong@ufl.edu

352-392-0831

Office Hours: WF 4 – 5 pm at NEB 227

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

Please contact through the Canvas website

- Sidharth Enagala, sidharthenagala@ufl.edu
 - He will hold a weekly Q&A session for homework (M 4 – 5 pm at MAE-A 221 or MAE-B 237).
- Rohit Reddy Amidi, rohitreddy.amidi@ufl.edu

Course Description

Steady-state and transient analysis of conduction and radiation heat transfer in stationary media. Heat transfer in fluid systems, including forced and free convection. Credits: 3

Course Pre-Requisites / Co-Requisites

EAS4101 or EGN3353C, EML3100

Course Objectives

This course provides an intermediate level coverage of thermal transport processes via conduction, convection, and radiation heat transfer. It stresses fundamental engineering science principles applied to thermal analysis. Students will learn to apply the conservation of energy to control volumes and express the conservation of energy through mathematical formulations, including both steady state and transient analyses, with emphasis on the fundamental physics and underlying mathematics associated with heat transfer. Upon completion of this course, students are expected to understand basic heat transfer solution techniques, coupled with a strong foundation and appreciation for the physics of heat transfer.

Relation to Program Outcomes (ABET):

The table below is an example. Please consult with your department's ABET coordinator when filling this out.

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	Medium
3. An ability to communicate effectively with a range of audiences	Low
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	Medium

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	Not Covered
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	Not Covered
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

- A Heat Transfer Textbook, 5th ed by John H. Lienhard IV and John H. Lienhard V
- Available online for free at <https://ahtt.mit.edu/>

Recommended Materials

- Fundamentals of Heat and Mass Transfer, 7th ed by T.L. Bergman, A.S. Lavine, F.P. Incropera, and D.P. DeWitt
- Modeling and Approximation in Heat Transfer, L.R. Glicksman and J.H. Lienhard V

Course Schedule

Lecture & assignment schedule is available on the last page.

Attendance Policy, Class Expectations, and Make-Up Policy

Students are responsible for participating, staying up-to-date on all announcements, in-class lectures, posted video lectures, reading assignments and homework. Even though class attendance will not be used for assigning grades, it is critical that students attend the class regularly for the successful completion of this course. 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/>

Homework

Homework assignments will be posted online every week and will be due Wednesday the following week at midnight (11:59 pm). Sidharth Enagala (sidharthenagala@ufl.edu) will conduct a weekly Q&A session for homework on Mondays 4 – 5 pm, with the homework due on the following Wednesday. All assignments should only be submitted through Canvas. All problem solutions and grades will be posted on Canvas. There will be in total 10 homework assignments. Show all your work, clearly mark answers, and be neat. Late submissions will not be accepted. Only exceptions are rare instances (medical emergency) with documentation and pre-approval by Dr. Song.

Exams

Midterm 1 – Feb. 12th, Monday 7 – 9 pm;
 Midterm 2 – Mar. 25th, Monday 7 – 9 pm;
 Final Exam – May 2nd, Thursday 3 – 5 pm;

Exam policy: Exams are closed book. You can bring one sheet of paper (8.5" x 11.5") with your notes on both sides. If you cannot attend exams due to non-emergency events (e.g. conflict with official university activities), you must contact Dr. Song one week prior to the exam with documentations. Make-up exams will only be given in rare instances such as medical emergencies with documentation and pre-approval by Dr. Song.

Evaluation of Grades

Assignment	Percentage of Final Grade
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Homework	20%
Midterm 1	25%
Midterm 2	25%
Final Exam	30%
Total	100%

Grading Policy

Any re-grade requests must be submitted to Dr. Song within a week after the grade is returned. Additional curves may be applied, as determined by the overall grade distribution of the class. Grade conversion will be based on the table below.

Instructor credit: active participants in class discussion/office hours may receive 1 – 5% bonus instructor credit.

Percent	Grade	Points
90 – 100	A	4.00
85 – 89.9	A-	3.67
80 – 84.9	B	3.00
75 – 79.9	B-	2.67
70 – 74.9	C	2.00
65 – 69.9	C-	1.67
60 – 64.9	D	1.00
0 – 59.9	E	0.00

More information on UF grading policy may be found at:

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

Notice of Copyright

Materials in this course – unless otherwise indicated – are protected by United States copyright law [Title 17, U.S. Code]. Materials are presented in an educational context for personal use and study and should not be shared, distributed or sold in print – or digitally – outside the course without permission.

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 varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

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
- HWCHE Human Resources, 352-392-0904, student-support-hr@eng.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/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.

EML4140 Heat Transfer – Spring 2024
Lecture & Assignment Schedule

Week	Date	Topic	HW Schedule
1	1/8 Mon	L01 Introduction	HW1 up
1	1/10 Wed	L02 Conduction: Basics, Fourier's law	
1	1/12 Fri	L03 Conduction: Basics, Fourier's law	
2	1/15 Mon	Holiday	
2	1/17 Wed	L05 Conduction: Steady-state, 1D	HW1 due
2	1/19 Fri	L06 Conduction: Steady-state, 1D	
3	1/22 Mon	L07 Conduction: Steady-state, 1D with heat generation	
3	1/24 Wed	L08 Conduction: Steady-state, 1D with heat generation	HW2 up
3	1/26 Fri	L09 Conduction: Stead-state, multi-dimension	
4	1/29 Mon	L10 Conduction: Stead-state, multi-dimension	HW2 Q&A at MAE-A 221
4	1/31 Wed	L11 Conduction: Stead-state, multi-dimension	HW2 due , HW3 up
4	2/2 Fri	L12 Conduction: Transient (Lumped capacitance)	
5	2/5 Mon	L13 Conduction: Transient (with Convection)	HW3 Q&A at MAE-A 221
5	2/7 Wed	L14 Conduction: Transient (Semi-infinite body)	HW3 due
5	2/9 Fri	L15 Conduction: Transient (Semi-infinite body)	
6	2/12 Mon	Midterm 1: Conduction	
6	2/14 Wed	L16 Convection: Basics	
6	2/16 Fri	L17 Convection: Basics, Governing equations	
7	2/19 Mon	L18 Convection: Similarity, Dimensional analysis	
7	2/21 Wed	L19 Convection: External flow (flat plate)	HW4 up
7	2/23 Fri	L20 Convection: External flow (flat plate)	
8	2/26 Mon	L21 Convection: External flow (others)	HW4 Q&A at MAE-A 221
8	2/28 Wed	L22 Convection: Internal flow	HW4 due , HW5 up
8	3/1 Fri	L23 Convection: Internal flow	
9	3/4 Mon	L24 Convection: Internal flow	HW5 Q&A at MAE-A 221
9	3/6 Wed	L25 Convection: Internal flow	HW5 due , HW6 up
9	3/8 Fri	L26 Convection: Natural convection	
10		Spring break	
11	3/18 Mon	L27 Convection: Heat exchanger	HW6 Q&A at MAE-A 221
11	3/20 Wed	L28 Convection: Heat exchanger	HW6 due
11	3/22 Fri	L29 Radiation: Basics	
12	3/25 Mon	Midterm 2: Convection	
12	3/27 Wed	L30 Radiation: Intensity	HW7 up
12	3/29 Fri	L31 Radiation: Blackbody	
13	4/1 Mon	L32 Radiation: Real surfaces	HW7 Q&A at MAE-A 221
13	4/3 Wed	L33 Radiation: Absorption, reflection, transmission	HW7 due , HW8 up
13	4/5 Fri	L34 Radiation: Kirchhoff's law	
14	4/8 Mon	L35 Radiation: Environmental radiation	HW8 Q&A at MAE-A 221
14	4/10 Wed	L36 Radiation: View factor	HW8 due , HW9 up
14	4/12 Fri	L37 Radiation: Black surface	
15	4/15 Mon	L38 Radiation: Grey surface	HW9 Q&A at MAE-A 221
15	4/17 Wed	L39 Radiation: Grey surface	HW9 due , HW10 up
15	4/19 Fri	L40 Radiation: Multimode heat transfer	
16	4/22 Mon	L41 Class Review	HW10 Q&A at MAE-B 237
16	4/24 Wed	L42 Class Review	HW10 due
17	5/2 Fri	Final Exam: All	