

Heat Transfer EML 4140, Section 289F (January 6, 2022)

Class Periods: MWF, 7th Period, 1:55-2:45pm

Location: Turlington Hall L011

Video Lectures are on Canvas under the Course Lecture Videos Tab

Academic Term: Spring 2022

Instructor

Dr. S.A. Sherif

sasherif@ufl.edu, 1-352-392-7821

Office Hours: TBA via Zoom

Teaching Assistants/Graders

- TA: Mahsa Frazaneh, mahsafarzaneh@ufl.edu, Office Hours TBA
- TA: Arash Shadlaghani, a.shadlaghani@ufl.edu, Office Hours M & F 10:30am-12:00 noon
- Grader 1, Abdulmajeed Alghamdi, alghamdia@ufl.edu
- Grader 2, TBA

Course Description

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

Course Pre-Requisites

MAP 2302 with minimum grade of C, EAS 4101 (Aerodynamics) or EGN 3353C (Fluid Mechanics)

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.

Materials and Supply Fees: N/A

Professional Component (ABET)

4A. EML 4140 supports several program outcomes enumerated in the Mission Statement of the Department of Mechanical and Aerospace Engineering. Specific ME program outcomes supported by this course include: (1) Using knowledge of chemistry and calculus-based physics with depth in at least one of them (ME Program Outcome M1); (2) Using knowledge of advanced mathematics through multivariate calculus and differential equations (ME Program Outcome M2); (3) Being able to work professionally in the thermal systems area (ME Program Outcome M4).

4B. Mathematical Sciences (15%), Physical Sciences (15%), Engineering Sciences (70%)

Relation to Program Outcomes (ABET)

This course achieves the following ABET outcomes [note that the outcome number corresponds to the respective ABET outcomes (1) through (7)]:

(1) Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics [Method of assessment is one or more exam or project problems]

(7) Ability to acquire and apply new knowledge as needed, using appropriate learning strategies [Method of assessment is several critiques of research papers in the field of Heat Transfer]

Required Textbooks and Software

One of these two books:

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

Fundamentals of Heat and Mass Transfer, T.L. Bergman, A.S. Lavine, F.P. Incropera, and D.P. DeWitt, 8th Edition, John Wiley & Sons, Inc., ISBN: 978-1-118-98917-3.

Recommended Materials: None

Course Schedule (Section numbers are from 7th Edition of the textbook)

First unit:

1. Introduction to heat transfer and rate laws
2. Fourier's Law and heat diffusion equation
3. Rate equations and conservation of energy
4. Introduction to conduction
5. One-dimensional steady-state conduction (planar, cylindrical, and spherical)
6. Contact resistance and thermal circuits
7. Heat transfer from extended surfaces (fins)
8. Two-dimensional steady state heat transfer: Conduction Shape Factors
9. Energy Balance method for nodal equations and boundary nodes
10. Transient conduction, lumped capacitance method
11. Transient conduction, spatial effects, exact and approximate solutions and Heisler Charts

Reading material:

1. Chapters 1 and 2
2. Chapter 3 (no porous media also omit 3.7, 3.8, 3.9)
3. Chapter 4 (omit 4.4, 4.5)
4. Chapter 5 (omit 5.8, 5.9, 5.10)

Second unit:

1. Introduction to convective transport processes
2. Introduction to boundary layers
3. Convective transport equations in differential form
4. Dimensionless variables and Reynolds analogy
5. Effects of turbulence
6. Introduction to external flow heat transfer
7. External flow heat transfer correlations
8. Introduction to internal flow heat transfer
9. Internal flow heat transfer coefficient and correlations
10. Introduction to natural convection
11. Natural convection heat transfer coefficient and correlations
12. Combined free and forced convection

Reading material:

1. Chapter 6
2. Chapter 7 (omit 7.7, 7.8)
3. Chapter 8 (omit 8.7, 8.8, 8.9)
4. Chapter 9

Third unit:

1. Introduction to radiation heat transfer exchange
2. Geometry, radiation intensity, emissive power
3. Irradiation and radiosity
4. Blackbody radiation exchange
5. Band emission
6. Emissivity, reflectivity, absorptivity, transmissivity
7. Kirchoff's Laws
8. Radiation view factors
9. Net radiation exchange among surfaces
10. Black body surfaces
11. Gray-Diffuse surfaces

Reading material:

1. Chapter 12 (omit 12.9)
2. Chapter 13 (omit 13.6)

Chapter 1:	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7
Chapter 2:	2.1, 2.2, 2.3, 2.4, 2.5,
Chapter 3:	3.1, 3.2, 3.3, 3.4, 3.5, 3.6
Chapter 4:	4.2, 4.3, 4.6
Chapter 5:	5.1 5.2, 5.3, 5.4, 5.5, 5.6, 5.7
Chapter 6:	6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8
Chapter 7:	7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.9
Chapter 8:	8.1, 8.2, 8.3, 8.4, 8.5, 8.6
Chapter 9:	9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 9.11
Chapter 12:	12.1, 12. 2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8
Chapter 13:	13.1, 13.2, 13.3, 13.4, 13.5 (Reading only/not on exams)

Exam Dates:

Exam 1: February 10, 2022, 8:00-10:30pm, Covering Chapters 1, 2, 3

Exam 2: March 16, 2022, 8:00-10:30pm, Covering Chapters 4, 5, 6

Exam 3: April 20, 2022, 8:00-10:30pm, Covering Chapters 7, 8

Exam 4: April 28, 2022, 12:30-2:30pm, Covering Chapters 9, 12

Attendance Policy, Class Expectations, and Make-Up Policy

Watching the 42 lecture videos will provide the most comprehensive and complete coverage for the course materials and is required. There will also be in-person lectures that will be announced one day in advance. These in-person lectures are structured to help you with your HW assignments and to answer your questions as well as to explain how to think and strategize about solving problems in Heat Transfer. They will be interactive to allow for exchanging ideas and for free thinking. There will also be Zoom help sessions for the HW assignments and for reviews before each exam. All in-person lectures as well as the Zoom help sessions will be recorded. Office hours will be announced in advance and will be on Zoom. Office hours that are labeled as "help sessions" will be recorded. Informal office

hours will not be recorded to give those attending the freedom to ask personal or informal questions. It is extremely important that students attend regularly and watch all materials presented. Irregular attendance always results in poor or mediocre performance. **Policy on Homework Assignments:** Homework problems will be assigned via Canvas and submitted through Canvas. No email or hard copy submissions will be accepted. Only two problems will be graded at random. A correct solution will be posted on Canvas. You may upload homework assignments early, but not past the due date. The assignments can be submitted until 11:59pm on the day the assignments are due. Late homework is not accepted via any other means. **Policy on exams:** There will be four exams equal in weight (21% of the course grade each). The 4th exam will be given during Finals Week in the time slot specified by the University. All exams will be virtual and will be submitted on Canvas by the specified due time on the day of the exam. None of the exams are comprehensive. Each exam will cover a portion of the course material as specified in this syllabus.

Miscellaneous Policies

Students will be held responsible for knowledge of all scheduling and policy announcements made in class. You may call Dr. Sherif or send him an e-mail 24 hours a day, 7 days a week at 352-392-7821. Please make sure you leave a phone number if you call and cannot find him. If you send an Email, please also list a phone number where you can be reached. Dr. Sherif will return your call within a few hours. Sending an Email along with the voice message can also help alert him to your request. Excused absences are consistent with university policies in the undergraduate catalog at the following URL: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx> Excused absences require appropriate documentation.

Evaluation of Grades

Assignment	Percentage of Final Grade
Homework	7%
Project 1/Assignment to measure Outcome (7)	3%
Project 2/Assignment to measure Outcome (1)	6%
Exam 1	21%
Exam 2	21%
Exam 3	21%
Exam 4	21%
Total Score	100%

Grading Policy

Percent	Grade	Grade Points
90 - 100	A	4.00
86 - 90	A-	3.67
82 - 86	B+	3.33
78 - 82	B	3.00
74 - 78	B-	2.67
70 - 74	C+	2.33
66 - 70	C	2.00
62 - 66	C-	1.67
58 - 62	D+	1.33
54 - 58	D	1.00
50 - 54	D-	0.67
0 - 50	E	0.00

Video Lecture Content and Exam Coverage

<u>Lecture #</u>	<u>Topic Covered</u>	<u>Lecture #</u>	<u>Topic Covered</u>
Lecture 1	Ch 1 & Ch 2 Introduction to Conduction	Lecture 24	Ch 7 External Forced Convection
Lecture 2	Ch 2 Heat Diffusion Equation	Lecture 25	Ch 7 External Flow & Ch 8 Internal Flow
Lecture 3	Ch 2 Heat Diffusion Equation	Lecture 26	Ch 8 Internal Flow
Lecture 4	Ch 2 Heat Diffusion Equation	Lecture 27	Ch 8 Internal Flow
Lecture 5	Ch 2 Heat Diffusion Equation/Ch 3	Lecture 28	Ch 8 Internal Flow
Lecture 6	Ch 3 1-D Steady State Conduction	Lecture 29	Ch 8 Internal Flow
Lecture 7	Ch 3 1-D Steady-State Conduction	Lecture 30	Ch 8 Internal Flow
Lecture 8	Ch 3 1-D Steady-State Conduction	Lecture 31	Ch 9 Free Convection
Lecture 9	Ch 3 Heat Transfer with Fins	Lecture 32	Ch 9 Free Convection
Lecture 10	Ch 3 Heat Transfer with Fins	Lecture 33	Ch 9 Free Convection
Lecture 11	Ch 3 Heat Transfer with Fins	Lecture 34	Ch 12 Thermal Radiation
Lecture 12	Ch 4 Steady State 2-D Conduction	Lecture 35	Ch 12 Thermal Radiation
Lecture 13	Ch 4 & Ch 5 Trans. Conduction/Lumped	Lecture 36	Ch 12 Thermal Radiation
Lecture 14	Ch 5 Transient Conduction (Lumped)	Lecture 37	Ch 12 Thermal Radiation
Lecture 15	Ch 5 Transient Conduction (Spatial)	Lecture 38	Ch 12 Thermal Radiation
Lecture 16	Ch 5 Transient Conduction (Spatial)	Lecture 39	Ch 12 Thermal Radiation
Lecture 17	Ch 6 Introduction to Convection	Lecture 40	Ch 12 Thermal Radiation
Lecture 18	Ch 6 Introduction to Convection	Lecture 41	Ch 12 Thermal Radiation
Lecture 19	Ch 6 Introduction to Convection	Lecture 42	Ch 12 Thermal Radiation
Lecture 20	Ch 6 Introduction to Convection	Exam 1	Covers Lectures 1 through 11
Lecture 21	Ch 6 & Ch 7 Ext. Forced Convection	Exam 2	Covers Lectures 12 through 21
Lecture 22	Ch 7 External Forced Convection	Exam 3	Covers Lectures 21 through 30
Lecture 23	Ch 7 External Forced Convection	Final	Covers Lectures 31 through 42

All exams are open book and notes and require attendance via both Zoom and Honorlock. Make sure your desktop or laptop is equipped with a webcam.

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.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/policies/student-honor-code-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

- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@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: <http://www.counseling.ufl.edu/cwc>, 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://www.crc.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://care.dso.ufl.edu>.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.