

Heat Transfer EML 4140, Section 261H (**Updated: August 26, 2024**) **New Exam 3 Date**

Class Periods: MWF, 9<sup>th</sup> Period, 4:05-4:55pm

Location: 109 Little Hall

Supplementary video lectures are on Canvas under the [Mediasite Course Lecture Videos Tab](#)

Academic Term: Fall 2024

### **Instructor**

Dr. S.A. Sherif

[sasherif@ufl.edu](mailto:sasherif@ufl.edu), 1-352-392-7821

Office Hours: MWF 5:30-6:30 on Zoom

### **Graders**

- Grader 1, Sanjeev Gowtham Saravanan, [sanjeevg.saravan@ufl.edu](mailto:sanjeevg.saravan@ufl.edu)
- Grader 2, Sumanth Eswar Kalluru Sureshbabu, [sumanthe.kalluru@ufl.edu](mailto:sumanthe.kalluru@ufl.edu)
- Grader 3, Hossein Papi, [hosseinpapi@ufl.edu](mailto:hosseinpapi@ufl.edu)
- Grader 4, Rohit Samala, [rohit.samala@ufl.edu](mailto:rohit.samala@ufl.edu)

### **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

### **ABET Student Outcomes**

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

- (1) **Outcome 1:** Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (**High**)
- (2) **Outcome 3:** Ability to communicate effectively with a range of audiences (**Low**).
- (3) **Outcome 4:** 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 (**Low**).
- (4) **Outcome 7:** Ability to acquire and apply new knowledge as needed, using appropriate learning strategies (**Low**).

### **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, 7<sup>th</sup> 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, 8<sup>th</sup> Edition, John Wiley & Sons, Inc., ISBN: 978-1-118-98917-3.

**Recommended Materials:** None

**Course Schedule** (Section numbers are from the 7<sup>th</sup> 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

#### **Exam Dates:**

**Exam 1: September 25, 2024, Evening exam, Covering Chapters 1, 2, 3**

**Exam 2: October 30, 2024, Evening exam, Covering Chapters 4, 5, 6**

**Exam 3: December 2, 2024, Evening exam, Covering Chapters 7, 8**

**Final Exam: December 11, 2024, 5:30-7:30pm, Covering Chapters 9, 12**

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

The lecture videos on Canvas are supplementary materials and will help you get more out of the course if you watch all of them or watch a portion of them. On the other hand, the in-person lectures cover the whole course, If you miss an in-person lecture make sure you watch the corresponding topic on video. Office hours will be on Zoom. There will be some help sessions on Zoom especially before the exams. These “help sessions” will be recorded. It is extremely important that students attend the class regularly. 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 4<sup>th</sup> exam will be given during Finals Week in the time slot specified by the University. All exams will be in person. None of the exams are comprehensive. Each exam will cover a portion of the course material as specified in this syllabus.

**No make-up exams will be given unless there is an extreme and documented emergency.**

#### **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%
Final Exam	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	<b>Exam 1</b>	<b>Covers Lectures 1 through 11</b>
Lecture 21	Ch 6 & Ch 7 Ext. Forced Convection	<b>Exam 2</b>	<b>Covers Lectures 12 through 21</b>
Lecture 22	Ch 7 External Forced Convection	<b>Exam 3</b>	<b>Covers Lectures 21 through 30</b>
Lecture 23	Ch 7 External Forced Convection	<b>Final</b>	<b>Covers Lectures 31 through 42</b>

All exams are open book and closed notes. Make sure you have a hardcopy book or print your eBook and bind it. You will need it during the exams (3-ring binding is not acceptable).

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 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 Undergraduate Coordinator
- HWCOE Human Resources, 352-392-0904, [student-support-hr@eng.ufl.edu](mailto:student-support-hr@eng.ufl.edu)
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, [pld@ufl.edu](mailto:pld@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](mailto:Learning-support@ufl.edu).  
<https://elearning.ufl.edu/>.

**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>.