Heat Transfer (January 12, 2021)
EML 4140

Class Periods: MWF, 7th Period, 1:55-2:45pm
Location: Online Video Lectures at the link below
https://ufedge.video.ufl.edu/Mediasite/Channel/spring2021-eml-4140

Academic Term: Spring 2021

Instructor
Dr. S.A. Sherif
sasherif@ufl.edu, 1-352-392-7821
Office Hours: MWF 7th Period (1:55-2:45pm) via Zoom

Teaching Assistants/Graders
- TA: Mahsa Frazaneh, mahsafarzaneh@ufl.edu, Office Hours T&Th 10:00am-12:00 noon
- Grader 1, Swaroop Thavva, swaroop.thavva@ufl.edu
- Grader 2, Sanchita Sanjay Surve, sanchitasurve@ufl.edu
- Grader 3, Mirav Rakholiya, miravrakholiya@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

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:**


**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 13 will not be on any exam

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 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, 2021, 8:00-10:30pm, Covering Chapters 1, 2, 3
Exam 2: March 16, 2021, 8:00-10:30pm, Covering Chapters 4, 5, 6
Exam 3: April 19, 2018, 8:00-10:30pm, Covering Chapters 7, 8
Final Exam: April 29, 2021, 10:00am-12:00 noon, Covering Chapters 9, 12

Attendance Policy, Class Expectations, and Make-Up Policy
Even though attendance is not required, it is extremely important that students attend the class regularly and watch the video lectures. 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.
**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 could 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](https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx)

Excused absences require appropriate documentation.

**Evaluation of Grades**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Percentage of Final Grade</th>
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<tbody>
<tr>
<td>Homework</td>
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<tr>
<td>Project 1/Assignment to measure Outcome (7)</td>
<td>3%</td>
</tr>
<tr>
<td>Project 2/Assignment to measure Outcome (1)</td>
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<tr>
<td>Exam 1</td>
<td>21%</td>
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<tr>
<td>Exam 2</td>
<td>21%</td>
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<tr>
<td>Exam 3</td>
<td>21%</td>
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<tr>
<td>Final Exam</td>
<td>21%</td>
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<tr>
<td><strong>Total Score</strong></td>
<td><strong>100%</strong></td>
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**Grading Policy**

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<thead>
<tr>
<th>Percent</th>
<th>Grade</th>
<th>Grade Points</th>
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<tbody>
<tr>
<td>90 - 100</td>
<td>A</td>
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<td>86 - 90</td>
<td>A-</td>
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<tr>
<td>82 - 86</td>
<td>B+</td>
<td>3.33</td>
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<tr>
<td>78 - 82</td>
<td>B</td>
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<tr>
<td>74 - 78</td>
<td>B-</td>
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<tr>
<td>70 - 74</td>
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<td>66 - 70</td>
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<td>62 - 66</td>
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<tr>
<td>58 - 62</td>
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<td>1.33</td>
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<td>54 - 58</td>
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<tr>
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Video Lecture Content and Exam Coverage

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

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

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://uflbluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.
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/](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](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](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](mailto:title-ix@ufl.edu), 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/](http://www.police.ufl.edu/).

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**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](https://lss.at.ufl.edu/help.shtml).

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. [https://www.crc.ufl.edu/](https://www.crc.ufl.edu/).

**Library Support**, [http://cms.uflib.ufl.edu/ask](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/](https://teachingcenter.ufl.edu/).


**Student Complaints Campus**: [https://care.dso.ufl.edu](https://care.dso.ufl.edu)