EML 4140 | Heat Transfer

Class Number: 18316

Instructor Information

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Course Details

Catalog Description: Steady state and transient analysis of conduction and radiation heat transfer in stationary media. Also discusses heat transfer in fluid systems, including forced and free convection.
Pre- and Co-Requisites: Prereq: MAP 2302 with minimum grade of C and (EAS 4101 or EGN 3353C).
Credit Hours: 3
Course Fees: $0.00

Required Materials

HEAT TRANSFER 'KITCHEN LAB EXPERIMENTS' (ITEMS LIST TO PURCHASE DISTRIBUTED 1ST WEEK OF CLASS)
Authors: AMAZON
All Access: This course does not use UF All Access

FUNDAMENTALS OF HEAT AND MASS TRANSFER, 8TH EDITION
ISBN: 1119722489
Authors: THEODORE L. BERGMAN, ADRIENNE S. LAVINE
Publisher: WILEY
Edition: 8
All Access: This course uses UF All Access

'LESS BORING LECTURES' YOUTUBE CHANNEL: HTTPS://WWW.YOUTUBE.COM/C/LESSBORINGLECTURES

Authors: ANDRES RUBIANO
All Access: This course does not use UF All Access

A HEAT TRANSFER TEXTBOOK, 6TH ED. (FREE ONLINE: HTTPS://AHTT.MIT.EDU/)
ISBN: 9780486837352
Authors: JOHN H. LIENHARD V, JOHN H. LIENHARD IV
Publisher: PHLOGISTON PRESS
Edition: 6
All Access: This course does not use UF All Access

Course Goals and Objectives

This course provides an intermediate level coverage of thermal transport processes via conduction, convection, and radiation heat transfer. This course stresses fundamental engineering science principles applied to engineering 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 problem formulation and solution techniques, coupled with a strong foundation and appreciation for the physics of heat transfer.

Expectations and Student Learning Outcomes

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)

Methods of Evaluation

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Evaluation Method	Number	Percent of Final Grade

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Homework	10	10%
Quizzes	4	36%
Kitchen Lab Activities	4	28%
"Hosted By Company" Projects	2	20%
Surveys & Incidentals	N	6%

Grading Scale

Letter grade and percentage

Letter	Percentage Value
A	94 - 100%
A -	90 - 93%
B +	87 - 89%
B	83 - 86%
B -	80 - 82%
C +	77 - 79%
C	73 - 76%
C -	70 - 72%
D +	67 - 69%
D	63 - 66%
D -	60 - 62%
E	59% and below

Course Schedule

Conduction

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 and cylindrical)
6. Contact resistance and thermal circuits, heat generation
7. Heat transfer from extended surfaces
8. Two-dimensional steady-state heat transfer: Finite difference method, Gauss-Seidel Method
9. Energy Balance method for nodal equations and boundary nodes
10. Transient conduction, lumped capacitance method
11. Transient conduction, exact solutions and Heisler Charts

Convection

I. Introduction to convective transport processes
II. Introduction to boundary layers
III. Convective transport equations in differential form
IV. Dimensionless variables and Reynolds analogy
V. Effects of turbulence
VI. Introduction to external flow heat transfer
VII. External flow heat transfer correlations
VIII. Introduction to internal flow heat transfer
IX. Internal flow heat transfer coefficient and correlations
X. Introduction to natural convection
XI. Introduction to phase change heat transfer

Radiation

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

Alignment of SLOs

Table of Course ABET Outcomes

Outcome	Coverage
An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
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
An ability to communicate effectively with a range of audiences	
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

Outcome	Coverage
An ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives	
An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
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.

University Policies and Resources

Information about grading policies, support for students with disabilities, course evaluations, the Honor Code, and other course policies and campus resources can be found on the Syllabus Policies page.

Attendance Policy

Excused and Unexcused Absences

Students may only participate in classes if they are registered officially or approved to audit with evidence of having paid audit fees. The Office of the University Registrar provides official class rolls to instructors.

Students are responsible for satisfying all academic objectives as defined by the instructor. Absences count from the first-class meeting.

Acceptable reasons for absence from or failure to engage in class include illness; Title IX-related situations; serious accidents or emergencies affecting the student, their roommates, or their family; special curricular requirements (e.g., judging trips, field trips, professional conferences); military obligation; severe weather conditions that prevent class participation; religious holidays; participation in official university activities (e.g., music performances, athletic competition, debate); and court-imposed legal obligations (e.g., jury duty or

subpoena). Other reasons (e.g., a job interview or club activity) may be deemed acceptable if approved by the instructor.

For all planned absences, a student in a situation that allows an excused absence from a class, or any required class activity must inform the instructor as early as possible prior to the class. For all unplanned absences because of accidents or emergency situations, students should contact their instructor as soon as conditions permit.

Students shall be permitted a reasonable amount of time to make up the material or activities covered during absence from class or inability to engage in class activities because of the reasons outlined above.

If a student does not participate in at least one of the first two class meetings of a course or laboratory in which they are registered, and they have not contacted the department to indicate their intent, the student can be dropped from the course. Students must not assume that they will be dropped, however. The department will notify students if they have been dropped from a course or laboratory.

The university recognizes the right of the instructor to make attendance mandatory and require documentation for absences (except for religious holidays), missed work, or inability to fully engage in class. After due warning, an instructor can prohibit further attendance and subsequently assign a failing grade for excessive absences.

Religious Holidays Guidelines

At the University of Florida, students and faculty work together to allow students the opportunity to observe the holy days of their faith. A student should inform the faculty member of the religious observances of their faith that will conflict with class attendance, with tests or examinations, or with other class activities prior to the class or occurrence of that test or activity. The faculty member is then obligated to accommodate that particular student's religious observances. Because students represent a myriad of cultures and many faiths, the University of Florida is not able to assure that scheduled academic activities do not conflict with the holy days of all religious groups. Accordingly, individual students should make their need for an excused absence known in advance of the scheduled activities.

The Florida Board of Education and state law govern university policy regarding observance of religious holidays.

Guidelines

- Students, upon prior notification to their instructors, shall be excused from class or other scheduled academic activity to observe a religious holy day of their faith.
- Students shall be permitted a reasonable amount of time to make up the material or activities covered in their absence.
- Students shall not be penalized due to absence from class or other scheduled academic activity because of religious observances.

If a faculty member is informed of or is aware that a significant number of students are likely to be absent from class because of a religious observance, the faculty member should not schedule a major exam or other academic event at that time.

A student who is to be excused from class for a religious observance is not required to provide a second party certification of the reason for the absence. Furthermore, a student who believes that they have been unreasonably denied an education benefit due to religious beliefs or practices may seek redress through the student grievance procedure.

Absence due to Illness

A student who is absent from class or any required class-related activity because of illness should contact their instructor, if feasible, as early as possible prior to the missed class or activity.

Students shall be permitted a reasonable amount of time to make up the material or activities covered during an excused absence.

Students should contact their college by the deadline to drop a course for medical reasons. Students can petition the Dean of Students Office to drop a course for medical reasons. The university's policy regarding medical excuse from classes is maintained by the Student Health Care Center.

Twelve-Day Rule

Students who participate in university-sponsored athletic or scholarly activities are permitted to be absent 12 scholastic days per semester without penalty. A scholastic day is any day on which regular class work is scheduled as defined in the approved university calendar.More Info

The student or student's advisor must notify the instructor as early as possible prior to the anticipated absence to allow ample time for accommodations. Instructors must be flexible

and not penalize students when re-scheduling during-term and final exams, class assignments, and other required activities and must follow the UF Attendance Policy herein and UF Examination Policies. As noted in the UF Examination Policies, during-term exams should be re-scheduled no later than before the end of the semester, while final exams no later than 90 days after the originally scheduled exam time. However, instructors are encouraged to re-schedule final and during-term exams, assignments, and other activities as soon as possible after the last day of the absence and must not penalize the student in any way.More Info

A group's schedule that requires absence of more than 12 scholastic days should be adjusted so that no student is absent from campus more than 12 scholastic days. Students who previously have been warned in writing by their instructor about the impact of absences on their individual class performance should not incur additional absences, even if they have not been absent 12 scholastic days. The student is responsible to maintain satisfactory academic performance and attendance.

Course Policies and Resources

Policies on Sources of Truth, Communication Channels, Use of AI, TurnItIn, Laboratory Access, & Assignment Grade Disputes:

1. Online platforms, notably GroupMe, provide venues for course discussion that exclude the instructor and Teaching Team. Discussion platforms beyond UF-sanctioned Learning Management Systems will not be monitored or curated by the instructor. Thus, information propagated through these platforms can be incorrect. It is each student's responsibility to verify information obtained from these external discussion services with reputable reference sources or UF-affiliated subject matter experts. Erroneous information obtained from external discussion platforms used in this class will be marked incorrect on graded assignments and assessments.
2. The course MS Teams General Channel is shared by the whole class and the Teaching Team for information dissemination. Individuals or teams who post comments or files not relevant to the class in the General Channel will be penalized one letter grade for each infraction.
3. Students taking this course consent to allowing all assignments to be submitted by the instructor on their behalf for textual similarity review to Turnitin.com via the Canvas learning management system for the detection of plagiarism and unattributed AI use. All submitted materials will be added as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. Use

of the Turnitin.com service is subject to the Usage Policy posted on the Turnitin.com site.

4. Use of Generative AI is accepted and encouraged in this class provided a} it occurs exclusively through UF's NaviGator Chat portal (https://it.ufl.edu/ai/navigator-chat/) and b} AI use is clearly identified and attributed in all submissions. AI generated content created outside the UF NaviGator Chat platform and/or that is not clearly identified and attributed is cheating under the UF Honor Code, section (a)2, https://regulations.ufl.edu/wp-content/uploads/2021/12/4-040_2021-12-06.pdf : "(a) Cheating. A Student shall not use or attempt to use unauthorized materials or resources in any academic activity for academic advantage or benefit. Cheating includes but is not limited to: 2. Using any materials or resources, through any medium, which the Faculty has not given express permission to use and that may confer an academic benefit to the Student." Unattributed material suspected of being AI-generated will be vetted through a detection algorithm. If this tool deems the material to be AI-generated, a 0 will be given on the suspected assignment.
5. If an individual or group has as assignment grading dispute, the issue must first be addressed with the Teaching Team member who did the grading. If individuals/groups can show where grading errors occurred, Teaching Team members will correct grades accordingly. Only after communication with a Teaching Team member fails to resolve a grading dispute may the individual/group bring the dispute to an instructor.
6. Grade disputes must be communicated to the Teaching Team in writing within 7 calendar days of the assignment's return to students. Any grade disputes lodged after the 7-day window will be ignored.

Technology in the Classroom

Required Computer

Students must have their own computer whose specifications meet or exceed the capabilities recommended by the University (https://it.ufl.edu/get-help/student-computer-recommendations/), required by the College (https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements/), and required by the MAE Department (https://mae.ufl.edu/academics/prospective/undergraduate/computer-requirements/).