Heat Transfer

EML 4140 Section 724C
Class Periods: MWF, 5, 11:45 am – 12:35 pm
Location: FAB 0G0103
Academic Term: Spring 2026

Instructor:
Subrata Roy
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(352) 392-9823
Office Hours: Wednesday 2:00-3:00 pm, NEB 435

Teaching Assistant/Peer Mentor/Supervised Teaching Student:
Please contact through the Canvas website

- No Teaching Assistant
- Grader: Riddhideep Biswas, rbiswas@ufl.edu

Course 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. Credits:3

Course Pre-Requisites / Co-Requisites
MAP 2302 with a minimum grade of C and (EAS 4101 or EGN 3353C).

Course 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.

Materials and Supply Fees
None

Relation to Program Outcomes (ABET):
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).

Mathematics	15%
Physical Sciences	15%
Engineering Science	70%

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	Medium

consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3. An ability to communicate effectively with a range of audiences	
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 environment, establish goals, plan tasks, and meet objectives	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
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 Textbooks and Software

- Fundamentals of Heat and Mass Transfer
- T.L. BERGMAN & A.S. LAVINE
- 8th Edition, Wiley
- 0471457280

Recommended Materials

- Title
- Author
- Publication date and edition
- ISBN number

Required Computer

Recommended Computer Specifications: https://it.ufl.edu/get-help/student-computer-recommendations/
HWCOE Computer Requirements: https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements/
The above requires a student to have a computer but allows for a Windows or a Mac. Add any particular or additional department or course specific requirements.

Course Schedule

Below is an *approximate* list of topics that will be covered in this class. *Recorded lectures from Fall 2021 are posted for reference only. I hope that reviewing these lectures before class will allow students deeper understanding of the subject. For homework* ***(check Assignments link).***

First unit: ~6 Weeks (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

Second unit: ~4 Weeks (Convection)

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. Introduction to phase change heat transfer

Third unit: ~4 Weeks (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

Important Dates

Exam I on Week 6 - **02/18/26**
Exam II on Week 10 - **03/25/26**
Exam III on Week 14 - **04/20/26**
Final Exam as Scheduled 4/29/2026 @ 10:00 AM - 12:00 PM

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Sets (10)	100 each	10%
Quizzes (4)	100 each	5%
Exam 1 Conduction	100	20%
Exam 2 Convection	100	20%
Exam 3 Radiation	100	20%
Final (Comprehensive)	100	25%
		100%

Grading Policy

Percent	Grade	Grade Points

93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

Academic Policies & Resources

To support consistent and accessible communication of university-wide student resources, instructors must include this link to academic policies and campus resources: https://go.ufl.edu/syllabuspolicies. Instructor-specific guidelines for courses must accommodate these policies.

Commitment to a Positive 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.

If you feel like your performance in class is being impacted, 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
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu