Heat Transfer: ME407-102

Spring 2025

Instructor Info:

Dr. Peter Balogh
Email: peter.balogh@njit.edu
Office: Mechanical Engineering Center (MEC) 324A

Lectures:

Wednesday 6:00PM – 8:50PM, Faculty Memorial Hall (FMH) 313

Office Hours:

Monday and Thursday, 1:00PM - 2:00PM or by appointment

Required Textbook:

Fundamentals of Heat and Mass Transfer, 8th Edition
by Bergman, Lavine, Incropera, and DeWitt
Wiley, 2020

Prerequisites:

MATH 222 – Differential Equations
ME 304 – Fluid Mechanics
ME 311 – Thermodynamics

Course Description:

A study of the three fundamental modes of heat transfer: conduction, convection, and radiation. A physical interpretation of the many quantities and processes in heat transfer using numerical methods. Theory is applied to the analysis and design of heat exchangers and other applications. Where appropriate, computer simulation is used.

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Course Policies

1. **Grading**

   Total of 100 points:

   - Homework (10)
   - Tests (20)
   - Midterm (20)
   - Final Exam (30)
   - Project (20)

   Scale:

A:	90-100
B+:	85-89
B:	80-84
C+:	75-79
C:	70-74
D:	60-69
F:	0-59

2. **Attendance and Lecture Notes**

   Attendance will not be graded. Lecture notes will be written on the board during class, and there will be no electronic version available (i.e. no powerpoint, etc.). Thus, it is extremely important that you attend every class and take good notes. While the lectures will be based on the sections/topics in your textbook as noted in the course schedule below, attending each class will go a long way towards doing well in this course and learning the material.

3. **NJIT Canvas**

- Canvas Webpage
- Log in and make sure your email address is correct, as all course notifications will be posted on Canvas
- HW assignments, exam information, general course announcements, etc. will be posted on Canvas

4. **Homework**

- Assignments are due at the beginning of class.
- Each problem must be worked through in a clear and logical manner with any assumptions clearly stated. The final answer must be clearly denoted.
- Partial credit will be given to problems in which the final answer is incorrect, with the amount dictated by my perception of how well you understand the problem. Thus, when working through a problem, the more detail you provide the better. Not only does this make for a more thorough analysis, but it will give you the best chance at maximizing partial credit for incorrect answers.

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5. **Tests and Exams**

- There will be two tests, a midterm, and a final exam (see schedule below)
- All tests and exams will be closed books / closed notes. However, I will allow a hand-written formula sheet(s) for each as specified prior to the respective test/exam.
- Failure to show up will result in zero points, and there are no make-ups. The only exceptions are for an officially documented excuse from the Dean of Students.

6. **Project**

- Near the middle of the semester there will be a project assigned with teams comprised of 2-3 students, and you will pick your own teams. This will involve application of theory learned in the course with open-source computational heat transfer software to solve a real-world heat transfer problem.
- Over the course of the project, each team will submit (see schedule below for tentative due dates):
    - A planning report outlining items such as project abstract and overview, roles of team members, etc. work schedule
    - A progress report outlining items such as summary of work to-date, status with regard to project schedule, and any difficulties encountered and plan for overcoming them.
    - A final report
- Specifics on the project and submission requirements will be provided when the project is assigned.

7. **Academic Integrity**

- "Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.
- Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu"

8. **Statement on Use of AI**

- This course expects students to work without artificial intelligence (AI) assistance in order to better develop their skills in this content area. As such, AI usage is not permitted throughout this course under any circumstance.

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Course Schedule (Tentative, subject to change)

Lecture	Date	Topics Covered	Assignment Due
1	1/22/25	Course Introduction Chapter 1: Introduction to Heat Transfer	
2	1/29/25	Chapter 2: Introduction to Conduction • Fourier's Law • Diffusion equation • Transient behavior	HW #1
3	2/5/25	Chapter 3: 1D, Steady-State Conduction • The Plane Wall • The Tube Wall • The Spherical Shell • Conduction w/ thermal energy generation	HW #2
4	2/12/25	Chapter 3: 1D, Steady-State Conduction • Fin analysis • Fin arrays	HW #3
5	2/19/25	**Test 1** (First half of class) Chapter 5: Transient Conduction • The lumped capacitance method	
6	2/26/25	Chapter 5: Transient Conduction • One term approximation • The semi-infinite solid	HW #4
7	3/5/25	Chapter 4: 2D Conduction • The Finite Difference Method • Steady State • Transient	HW #5
8	3/12/25	**Midterm** (First half of class) Chapter 6: Introduction to Convection • Boundary Layer Concepts • Heat Transfer Coefficients Assign Computer Project	
-	3/19/25	**SPRING BREAK**	
9	3/26/25	Chapter 6: Introduction to Convection • Dimensionless Parameters in the BL • Reynold's Analogy Chapter 7: External flow • Flat plate in parallel flow • Cylinder in cross flow • The sphere	HW #6

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10	4/2/25	Chapter 8: Internal flow • Developing and Fully Developed • Mean Temperature • Heat transfer correlations • Entry length effects	HW #7 Project Planning Report
11	4/9/25	**Test 2** (First half of class) Chapter 9: Free convection • Laminar boundary layer • Boussinesq approximation • Similarity considerations	
12	4/16/25	Chapter 10: Boiling and Condensation • Pool boiling • Film boiling • Film condensation Chapter 11: Heat Exchangers • Parallel and counter flow analysis • Log mean temperature difference • Effectiveness-NTU method	HW #8 Project Progress Report
13	4/23/25	Chapter 12: Radiation • Basic Principles • Blackbody Radiation • Real Surfaces	HW #9
14	4/30/25	Chapter 13: Radiation exchange • View Factors • Enclosures • The Re-Radiating Surface • Multi-Mode Effects	HW #10 Project Final Report

FINAL EXAM: TBD