MAE 310
Heat Transfer Fundamentals
Summer 2025

Instructor: Pouria Zaghari
Lectures: M-F 10:20am-11:50am, 2213 Engineering Building III
Office Hours: Sections 651: Thu 2:30pm-3:30pm or by appointment (via Zoom)
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1.1. Course prerequisites: MA 341 and C- or better in MAE 201

1.2. Required Textbook: Fundamentals of Heat and Mass Transfer, 8th Ed, by Bergman, Lavine, Incropera & DeWitt, John Wiley & Sons.

1.3. Course Support: https://wolfware.ncsu.edu/

1.4. Student learning outcomes for the course

Course Motivation: This course is an introduction undergraduate level class on heat transfer. It provides the basic tools necessary for the analysis of thermal conduction, thermal convection, and thermal radiation.

Course Objectives: The students will be asked to demonstrate their knowledge of the material covered in MAE 310 through their mastery of the following course objectives. Through the study of MAE 310 the students will be able to:

1. Determine surface temperature or heat rate by performing control surface energy balances;
2. Calculate heat rate using Fourier's law, Newton's law of cooling, and the Stefan-Boltzmann law;
3. Calculate interface temperatures, and or, heat rates for 1-D steady state heat transfer problems using the electrical resistance circuit analogy;
4. Determine the temperature distribution, heat rate, and performance of 1-D fins;
5. Determine 2D steady-state temperature distributions using finite difference techniques;
6. Determine 1D transient temperature distributions using separation of variables and finite difference techniques;
7. Determine 3D transient temperature distributions using the product solution technique;
8. Understand the concept of a velocity and thermal boundary layer, calculate boundary layer thickness, displacement thickness, momentum thickness, wall shear stress and convective heat transfer coefficient and determine whether the boundary layer is laminar or turbulent;
9. Calculate convective heat transfer rates for external forced convection of flat plates, cylinders, spheres and tube bundles;
10. Calculate convective heat transfer rates for internal laminar and turbulent flow for fully developed and developing flows;
11. Calculate convective heat transfer rates for buoyancy driven flows over flat plates, cylinders, spheres and in enclosures;
12. Determine the total and spectral blackbody emissive powers, surface radiation properties and radiation view factors;

13. Calculate surface temperature or heat rate of gray diffuse surface enclosures.

1.5. Projected schedule and reading assignments

Date	Topic	Readings
Week 1	Lecture 1: Course outline, intro to heat transfer, rate eqns. Lecture 2: Rate equations examples, conservation of energy Lecture 3: Introduction to conduction Lecture 4: 1D SS heat cond., thermal resistance, composite systems Lecture 5: Contact resistance, radial systems	1.1, 1.2 1.2, 1.3 2.1-2.4 3.1.1, 3.1.2, 3.1.3 3.1.4, 3.3
Week 2	Lecture 6: Heating elements, finned surfaces Lecture 7: Fin selection, fin arrays, fin performance Lecture 8: 2D SS heat conduction, separation of variables, shape factors Lecture 9: 2D SS heat conduction, FD method Lecture 10: Transient heat conduction – lumped model **HW1 Deadline: July 4th**	3.5, 3.6 3.6 4.1, 4.2, 4.3 4.4 5.1, 5.2
Week 3	**Test 1: July 7th (Lectures 1-5)** Lecture 11: Transient analytic solutions - plane wall, radial systems Lecture 12: Semi-infinite solids, product solution Lecture 13: Convection, flow regimes, Reynolds number Lecture 14: Boundary layer flow **HW2 Deadline: July 11th**	 5.5, 5.6 5.7, 5.8 6.1-6.3 7.1-7.6
Week 4	**Test 2: July 14th (Lectures 6-10)** Lecture 15: Internal flow – laminar Lecture 16: Internal flow – turbulent m^2 Lecture 17: Empirical correlations, natural convection Lecture 18: Horizontal plates, channels, enclosures **HW3 Deadline: July 18th**	 8.1-8.4 8.5-8.6 7.1, 9.1-9.5 9.6-9.8
Week 5	**Test 3: July 21nd (Lectures 11-14)** Lecture 19: Thermal radiation Lecture 20: Blackbody radiation Lecture 21: Definition of view factors Lecture 22: Radiation exchange, radiation shields **HW4 Deadline: July 25th**	 12.1-12.3 12.4 13.1 13.2, 13.3
	Final Exam: July 28th (Lectures 1-22)	

1.6. Grading

Homeworks	15%
Test 1	15%
Test 2	15%
Test 3	15%
Final Exam	40%

The final grade will be based on the final average and determined as follows:

Letter	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
Highest%	100.0	96.9	92.9	89.9	86.9	82.9	79.9	76.9	72.9	69.9	66.9	62.9	59.9
Lowest%	97.0	93.0	90.0	87.0	83.0	80.0	77.0	73.0	70.0	67.0	63.0	60.0	0

1.7. Course Policies

1.7.1 Lectrures

The recorded lectures will be uploaded on Panapto after each class. The lecture slides and notes will be posted on the Moodle page.

1.7.2 Exams

The link to the exams will be posted on the Moodle page. The students have 24hr to participate in the exams. All materials need to be scanned and submitted for grading.

Exams are open books/open notes, but no electronic devices are allowed. Credit will not be given for answers without supporting analyses. There must be no collaboration on the exams.

1.7.3 Homeworks

Homeworks will be assigned on Friday of the current week of class and will be due on Friday of the next week. The homeworks will be posted as Moodle Assignments set up for electronic submission and grading. Please submit your files as PDF (preferred) or web image files. There is a limit of 10 files/10 MB total for each submission.

1.7.4 Office hours

I will conduct my office hours in person (section 001) and on Zoom (sections 651 and 655). Option for irregular office hours: you can always set up an appointment for meeting.

1.7.5 Instructor's Academic Integrity statement

The faculty acknowledges the existence of the University policy on academic integrity found in the http://studentconduct.ncsu.edu/ and expects students to adhere to it. It is the expectation of faculty that students neither give nor receive unauthorized aid on any test, exam, or special assignment. The faculty recognizes the value of discussions by students regarding weekly homework assignments in student groups, with teaching assistants, and the faculty. However, homework assignments submitted for grading must be the product of the student submitting the work. Possession of copies of a solution manual by students is prohibited.

Note: this syllabus is not a contract and can be altered at any point with advanced notice to accommodate the educational goals of the course.