Course Syllabus — ENPM651

Heat Transfer for Modern Applications

ENPM651
Spring/2022

Course Overview

The course presents the three modes of heat transfer: conduction, convection, and radiation. One- and two-dimensional steady state and transient conductions are studied. The lumped capacitance analysis is used for transient conduction when suitable. Convection heat transfer is studied in both external and internal flow cases and under laminar and turbulent flow regimes. Free convection is also studied where the heat transfer is due to flow induced by fluid buoyancy. Radiation heat transfer is studied by considering both the general characteristics of radiation along with the properties of radiating surfaces and radiation heat transfer between surfaces. For each subject, real engineering examples will be tackled by using Engineering Equations Solver and Coil Designer software. As an application of multi-mode heat transfer principles, the design and optimization of air-to-refrigerant heat exchangers is studied in the course.

Learning Outcomes

After successfully completing this course you will be able to:

- Understand the importance of basic and complex heat transfer modes
- Analyze heat transfer processes for electronics, heating, cooling, power and industrial applications
- Apply heat transfer concepts in real heat exchanger design
- Design thermal components and systems

**Research Professor,
Yunho Hwang**
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Class Meets
Thursday
7:00 – 9:40 pm
TBA

Office Hours
4164 Glenn Martin Hall Bldg
Thursday, 5:30-6:30 pm and by appointment

Teaching Assistants
N/A

Prerequisites
Undergraduate Transfer Processes

Course Communication
I will use ELMS announcement for the project assignments and exams. Emails and ELMS site will be used for general communication.

Required Resources

Course website: https://umd.instructure.com/courses/1318789

Readings:

Heat Transfer by Gregory Nellis and Sanford Klein, Paperback, ISBN-13: 978-0521881074, Cambridge University Press, eTextBook, 2009.

Hardware/Software:

Engineering Equations Solver and Coil Designer software will be used.

Both are available from UMD's virtual Computer Lab at https://eit.umd.edu/vcl

Supplemental Resources

Readings:

Fundamentals of Heat and Mass Transfer by Frank P. Incropera, David P. Dewitt, 6th Edition, ISBN: 9780471457282, John Wiley & Sons, Inc.

Hardware/Software:

None

Campus Policies

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses. Please visit https://academiccatalog.umd.edu/graduate/policies/academic-record/ for the Office of Graduate Studies' list of campus-wide policies.

Activities, Learning Assessments, and Expectations

1. Projects (50% of grade)

There will be seven design projects assigned applying concepts learned from the class.

I expect students to understand concepts learned and be able to apply them in real-world design.

Projects are due in one week.

2. Mid-term exam (20% of grade)

There will be an in-class mid-term exam to test student's understanding on lessons learned. Neither calculator nor computer access is allowed.

I expect students to fully understood class materials.

However, one-page own study note is acceptable.

3. Final Project (20% of grade)

Instead of final exam, there will be a final design project using CoilDesigner software.

I expect students to be able to apply concepts learned to real design application.

Final project due is two weeks and there will be a final project presentation.

4. Attendance/Course Evaluation (10%)

I expect students to attend all classes in order to engage in the class lectures, make progress in learning, and interact with lecturer and fellow students.

Course Specific Policies

- Late-work will not be accepted for course credit.
- No penalty for excused absences but there will be a penalty for class absence.
- I will get back to your email within 24 hrs. except weekends.
- For this course, some of your assignments will be checked via Turnitin on our course ELMS page. I have chosen to use this tool because it can help you improve your scholarly writing and help me verify the integrity of student work. For information about Turnitin, how it works, and the feedback reports you may have access to, visit Turnitin Originality Checker for Students.

Accessibility and Reasonable Accommodations

The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The University of Maryland provides reasonable accommodations to qualified individuals. Reasonable accommodations shall be made in a timely manner and on an individualized and flexible basis.

Discrimination against individuals on the grounds of disability is prohibited. The University also strictly prohibits retaliation against persons arising in connection with the assertion of rights under this Policy.

Accessibility & Disability Service (ADS) facilitates reasonable accommodations to qualified individuals. For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301.314.7682, or adsfrontdesk@umd.edu. More information is available from the Counseling Center.

Get Some Help!

You are expected to take personal responsibility for your own learning. This includes acknowledging when your performance does not match your goals and doing something about it. Everyone can benefit from some expert guidance on time management, note taking, and exam preparation, so I encourage you to consider visiting http://ter.ps/learn (there are specific resources for graduate students under handouts, but please explore to find what you need). Sharpen your communication skills (and improve your grade) by visiting https://gradschool.umd.edu/graduate-school-writing-center and schedule an appointment with the campus Graduate Writing Center. Finally, if you just need someone to talk to, visit http://www.counseling.umd.edu.

Everything is free because you have already paid for it, and **everyone needs help**… all you have to do is ask for it.

Names/Pronouns and Self Identifications

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). The pronouns someone indicates are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity, is your choice whether to disclose (e.g., should it come up in classroom conversation about our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Grades

Grades are not given, but earned. Your grade is determined by your performance on the learning assessments in the course and is assigned individually (not curved).

All assessment scores will be emailed personally. If you would like to review any of your grades (including the exams), or have questions about how something was scored, please email me to schedule a time for us to meet in my office.

Late work will not be accepted for course credit so please plan to have it submitted well before the scheduled deadline. I am happy to discuss any of your grades with you, and if I have made a mistake I will immediately correct it. Any formal grade disputes must be submitted in writing and within one week of receiving the grade.

Your course work is graded by your Design Projects (50%), Mid-term exam (20%), Final Project (20%) and Attendance / Course Evaluation (10%).

Final letter grades are assigned based on the percentage of total assessment points earned. To be fair to everyone I have to establish clear standards and apply them consistently, so please understand that being close to a cutoff is not the same as making the cut ($89.99 \neq 90.00$). It would be unethical to make exceptions for some and not others.

Final Grade Cutoffs									
+	97.00%	+	87.00%	+	77.00%	+	67.00%		
A	94.00%	B	84.00%	C	74.00%	D	64.00%	F	<60.0%
-	90.00%	-	80.00%	-	70.00%	-	60.00%		

Course Schedule

Topic	Date	Assignment
EES Introduction	1/27	
1-D Steady-State Conduction	2/3, 2/10	Project 1: 1D Conduction Analysis

		Project 2: 1D Conduction Numerical Analysis
2-D Steady-State Conduction	2/17, 2/24	Project 3: 2D Conduction-Shape Factor
Transient Conduction	3/3	
External Forced Convection	3/10	Project 4: External Forced Convection
Mid-term Exam	3/17	Mid-term exam
Spring break	3/24	
Internal Forced Convection	3/31	Project 5: Internal Convection
Free Convection	4/7	Project 6: Free Convection
Boiling and Condensation	4/14	
Heat Exchanger Design	4/21	Final Project: Heat Exchanger Design
CoilDesigner Introduction	4/28	
Final Project Presentation	5/4	