

ME 2240 A Heat and Mass Transfer (GC)

Semester	Spring 2026
Classroom	Waterman 413
Meeting time	8:30–9:45
Instruction	Yves Dubief, ydubief@uvm.edu Office hours: T 10:00-11:30, W 12:30-2:00 Votey 201A or by appointment
TA(s)	TBA Office hours: TBAS
Prerequisites	ME 2230, Python
Note 1:	ME 2240 satisfies the GC1 Catamount Core requirement. GC1 courses address systems and problems that are global in scope. These courses will help students understand the nature and complexity of global phenomena. ME 2240 address ecological, technological, and human health problems related to heat and mass transfer in our increasingly interdependent world. Students will explore both the unique emerging problems and the opportunities created by such interdependence and interconnectedness.
Note2:	Heat transfer problem are mostly solved in python. Students are expected to bring their python-able laptop or tablet to all classes. This class uses Jupyter for python IDE. Miniforge is the recommended python installation. Students are also expected to install a working LATEX distribution for their Windows or Mac operating system.
Credit hours	3
Textbook	Optional: Fundamentals of Heat and Mass Transfer, 8th Edition, ISBN-13: 978-1119582786 Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt
Software	Python 3 with jupyter lab https://github.com/yvesdubief/UVM-ME144-Heat-Transfer

Course description

One- and two-dimensional steady and unsteady thermal conduction; natural and forced internal and external convection; thermal radiation; heat exchangers; boiling and condensation heat transfer, mass transfer, heat and mass transfer in the context of global citizenship

Course objectives

- a) To demonstrate the ability to understand and identify relevant modes of heat transfer in physical problems and to demonstrate the ability to apply conservation of energy in heat transfer problem.
- b) To demonstrate the ability to analyze 1D and solve multi-dimensional steady-state heat conduction in bodies with various thermal boundary conditions and multiple component materials.
- c) To demonstrate the ability to model and simulate unsteady simplified heat transfer problems with appropriate boundary conditions including phase change.
- d) To demonstrate the ability to understand the mechanisms of convective and radiative heat transfers and to demonstrate the ability to utilize analytical and empirical relations for the solution of engineering heat transfer problems.

- e) To demonstrate the ability to design a heat transfer system based on many factors (e.g. historical or forecasted weather data) and many constraints such as optimization of costs, minimization of environmental and/or health impacts.
- f) 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.
- g) Students will understand major implications of climate change on human habitat, including their historic and contemporary interconnections and the differential effects of human organizations and actions.
- h) Students will be able to plan, discern, and evaluate appropriate complex solutions to the challenges posed by climate change using multiple disciplinary scientific perspectives .

Grading scheme

There will be 8 individual homework assignments, 2 exams, and 3 group projects (2 small projects, and one final project building on the small projects). The final grade is based on three overall grades HW , E , P :

- HW assignments (HW): Average of all homework grades
- Exam grade E is a function of two exam grades E_1 and E_2 : $E = \alpha \min(E_1, E_2) + (1 - \alpha) \max(E_1, E_2)$. α is typically 0.15 but may be adjusted depending on grade distribution.
- Project grade P is a function of two small project P_1 , P_2 and one final project P_f : $P = (\min(P_1, P_2) + 2 \max(P_1, P_2) + 4P_f)/7$

The final grade is

$$\text{Final grade} = 0.25HW + 0.35E + 0.4P \quad (1)$$

There is no final exam, the final project is due on the Wednesday of exam week. The two in-class exams will be staggered. Half the class will take their exam on Tuesday, the other on Thursday. During exams, a formula sheet is provided, your own formula sheet is accepted. No textbook or electronics are allowed. Exams are designed to test theoretical knowledge of heat transfer and proficiency in problem solving of heat transfer problem. Exams may contain algebraic derivations, but no complex numerical calculations.

Projects are solved by groups of 2 students. The two small projects will have a turnaround time of 2 weeks. These two projects will build on mostly-completed codes. The focus of these projects will be mostly interpretations and discussions of the results of the projects. The final project builds on the codes developed in the first two projects. The project will be proposed early April, with the last 3 weeks of class consisting of one special topics lecture on Tuesdays and in-class project work on Thursday. Metrics of assessment will be provided for each project.

Letter grade distribution

100.0--96.00	A+	73.00--76.99	C
95.99--93.00	A	70.00--72.99	C-
90.00--89.99	A-	67.00--69.99	D+
87.00--89.99	B+	63.00--66.99	D
83.00--86.99	B	60.00--62.99	D-
80.00--82.99	B-	59.99--00.00	F
77.00--79.99	C+		

Policies

Classroom Environment Expectations

- Working in groups is encouraged at the beginning of the semester. If so, please enter the names of students in your study group at the beginning of the notebook.
- You are expected to follow the Code of Academic Integrity of the University of Vermont and expectations written in Our Common Ground. Any act plagiarism will result in no more than one warning. Further violation of the academic integrity contract will result in a report to the Center for Student Conduct and a grade of zero for the assignment.
- Office hours will be conducted in person or online upon request prior to the beginning of office hours via a message to the TA or instructor on Teams.
- You are encouraged to use the Teams channel to ask questions related to assignments, please tag the instructor in your message.
- In any interaction, be courteous and productive.
- Instructor and TA will do their very best to answer your question posted within 24 hours, Monday to Friday.

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Late assignment

Assignments are expected to be uploaded on blackboard in the requested format by the deadline set by the instructor. Late assignment will result in a loss of 10/100 points. With sufficient justification, you may ask for an extension no later than 48 hours before the deadline. Please contact the instructor as soon as you can in case of an emergency.

Tentative schedule

GC project are global citizenship projects.

Week	Content
1-2	Thermodynamics, Modes of heat transfer, Fourier's law, heat transfer coefficients, heat rate, heat transfer
2-3	Thermal resistance, Python libraries
3-4	1D planar and radial conduction heat transfer. Numerical simulations of transient 1D heat transfer. GC Project 1: Heat insulation vs. heat storage
4-5	Heat and Mass Convective transport, External convection flows
5-6	Internal convection flows, and natural convection flows.
7	Exam week
8-9	Heat and mass transfer in the atmosphere. GC Project 2: Simulation of energy cost of a building
10	Heat exchangers
11	Phase change
12	Radiation
13-15	GC Final Project: Over-the-summer snow storage in a building to reduce the carbon footprint of cross country skiing.
13	Special topics: Transport of nanoparticles in air
14	Special topics: Cooling of processing units
15	Exam week

Relationship to ABET Student Outcomes

Level of instruction 0—Little or none 1—moderate 2—strong	Student Outcome indicator (1-7)	Student Outcome
2	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2	2	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
2	3	an ability to communicate effectively with a range of audiences
2	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
2	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
2	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
1	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Statement on AI

The use of **any** AI is prohibited in this class, yet I understand that my ability to impose this requirement is almost impossible. As students of this class, and experts in thermodynamics, you are expected to understand

the energy, water, and carbon cost of generative AI and the impact on critical thinking. You are reminded that one of the most valuable skills, if not the most valuable, to your future employer is your critical thinking.

Statement about Academic Integrity

<https://www.uvm.edu/policies/student/acadintegrity.pdf>

Statement on Alcohol and Cannabis in the Academic Environment

As a faculty member, I want you to get the most you can out of this course. You play a crucial role in your education and in your readiness to learn and fully engage with the course material. It is important to note that alcohol and cannabis have no place in an academic environment. They can seriously impair your ability to learn and retain information not only in the moment you may be using, but up to 48 hours or more afterwards. In addition, alcohol and cannabis can:

- Cause issues with attention, memory and concentration
- Negatively impact the quality of how information is processed and ultimately stored
- Affect sleep patterns, which interferes with long-term memory formation

It is my expectation that you will do everything you can to optimize your learning and to fully participate in this course.

Statement on Students with Disabilities

In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact SAS, the office of Disability Services on campus. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly encouraged to meet with their faculty to discuss the accommodations they plan to use in each course. A student's accommodation letter lists those accommodations that will not be implemented until the student meets with their faculty to create a plan. Contact SAS: A170 Living/Learning Center; 802-656-7753; access@uvm.edu; or www.uvm.edu/access

Statement on Religious Holidays

Students have the right to practice the religion of their choice. Each semester students should submit in writing to their instructors by the end of the second full week of classes their documented religious holiday schedule for the semester. An arrangement can then be made to make up the missed work.

Statement on Student Athletes

In order to be excused from classes, student athletes should submit appropriate documentation to the Professor in advance of all scheduling conflicts within the first two weeks of class. Those missing class are expected to submit make-up assignments within a reasonable time period.

Availability of Class Recordings

The instructor attempts to record every lecture, barring technical difficulties. You may request access to the live streaming or recording if:

- You are sick and unable to attend. Please contact the instructor via Teams at least 5 mins before the start of class.
- You have an excused absence. Please remind the instructor prior to your absence.
- The recordings may help with the notes you took during the lecture.

In-person attendance should be prioritized, therefore the instructor has the right to decline access repeated requests without appropriate documentation for the justification of absences.