

CARLETON UNIVERSITY
Department of Mechanical and Aerospace Engineering
MECH 4407A: Heating and Air Conditioning
Winter 2023

Prerequisite - MAAE 2400: Thermodynamics and Heat Transfer

Course Description

The process of heating and cooling both revolve around the addition or removal of thermal energy, also called heat energy. Energy in all its forms cannot be created or destroyed. It can, however, be changed from one form to another. The natural direction of heat flow is from a warmer to a cooler body. Nevertheless, for the cooling purposes in the summer, heat needs to be removed from a cooler room and be dissipated in a warmer space. As such, according to the second law of thermodynamic some work needs to be done.

This course is an introduction to the design of thermal systems for indoor climate control. The major topics include human comfort requirements, outdoor climate variables, psychrometrics, heating and humidification loads, cooling and dehumidification loads, solar radiation, ventilation requirements and criteria, central system types and selection, energy estimation methods, piping, pumps, ducting, fans, heat exchangers, and refrigeration.

No deviations from previous years.

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Contact information:

Instructor: Dr. Suraj JOSHI (suraj.joshi@carleton.ca)
Teaching Assistant: Angelique Catcha-Picard
Lecture: Wednesdays, 11:35 am – 2:25 pm
Venue: St. Patrick's Building room: 303
Office: Mackenzie Building room: 2186
Office Hours: Wednesdays, 2:45 pm - 3:45 pm in-person

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Textbook and References:

"Heating, Ventilating and Air Conditioning - Analysis and Design," 6th ed, F. C. McQuiston, J. D. Parker and J. D. Spitler, John Wiley & Sons, 2005.

"Principles of heating ventilating and air conditioning"; Based on the 2017 ASHRAE Handbook Fundamentals," 8th ed., Howell, Ronald H. ASHRAE Publications, 2017.

Manual J, Residential Load Calculations, Hank Rutkowski, 8th ed. version 2, ACCA, 2006.

Manual D - Residential Duct Systems, Hank Rutkowski, ACCA.

Water Piping and Heat Pumps – Manual, ACCA.

ASHRAE Handbooks

Course Outline:

Date	Chapters	Course Activity
11 Jan	1, 2, 4	Introduction, Air-conditioning Systems, Comfort and Health - Indoor Air Quality
18 Jan	3	Moist Air Properties and Conditioning Processes
25 Jan	5	Heat Transmission in Building Structures
01 Feb	6	Space Heating Load; Quiz 1
08 Feb	7	Solar Radiation
15 Feb	8	The Cooling Load, Heat Balance Method
22 Feb	Winter Break	
01 Mar	Midterm Examination	
08 Mar	8, 9	Heat Balance Method contd., Energy Calculations
15 Mar	10	Flow, Pumps, and Piping Design;
22 Mar	11	Space Air Diffusion; Quiz 2
29 Mar	12	Fans and Building Air Distribution
05 Apr	14	Extended Surface Heat Exchangers
12 Apr	15	Refrigeration

Assessment components:

Two Quizzes (closed book + notes, 5% each):	10%
Midterm Examination (open book + notes):	30%
Final Examination (open book + notes):	60%
Total:	100%

e-Proctoring: Please note that in case any evaluation component is conducted online, tests and examinations in this course will use a remote proctoring service provided by Scheduling and Examination Services. You can find more information at <https://carleton.ca/ses/e-proctoring/>.

Graduate Attributes:

A knowledge base for engineering and problem analysis. The course MECH 4407 develops specialized engineering knowledge in the field of Heating, Ventilation and Air Conditioning. It attempts to foster an ability to use appropriate knowledge and skills to identify, analyze, and solve complex engineering problems to reach substantiated conclusions.

Notes:

1. The final exam is for evaluation purposes only and will not be returned to students.

2. *Academic Accommodation:* You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see the Student Guide (<http://www2.carleton.ca/equity/accommodation/academic/students/>).

Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see the Student Guide (<http://www2.carleton.ca/equity/accommodation/academic/students/>).

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally scheduled exam (if applicable).