# ME 402 – Thermal Systems Design

**Course Policy and Syllabus – Fall Semester 2025**

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| **Instructor:** | **Teaching Assistant:** |
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# Course Description:

This course covers the modeling, analysis, and design of vapor compression refrigeration systems applied to air-conditioning and refrigeration applications. There will be an emphasis on practical understanding of components, system integration, and system design. This includes analysis and selection of compressors, heat exchangers and expansion devices as well as the integration of these components into system.

# Course Objectives:

1. To provide the fundamentals necessary for analysis and modeling of vapor compression refrigeration equipment*.*
2. To develop a detailed understanding of *vapor compression systems*, and *other advanced heat pumping equipment*.
3. To develop a methodology to design a vapor compression refrigeration cycle for various applications and/or regulatory environments.

# Text Book:

None required.

# Reference Books:

1. Textbooks:
   1. Moran M. J. and Shapiro H. N., 2016. *Fundamentals of Engineering Thermodynamics*, 8th Ed., New York: J. Wiley & Sons.
   2. Bergman, T.L., Incropera, F.P., DeWitt, D.P., and Lavine, A.S. 2011. *Fundamentals of Heat and Mass Transfer*. 7th Ed., New York: J. Wiley & Sons.
2. ASHRAE Handbooks:
   1. 2013 ASHRAE Handbook, Fundamentals
   2. 2014 ASHRAE Handbook, Refrigeration
3. HVAC&R Textbooks:
   1. Mitchell, J. W., Braun, J.E., Principles of Heating, Ventilation, and Air Conditioning in Buildings, 1st ed., New York: John Wiley & Sons.
   2. McQuiston, F.C., Parker, J.D., and Spitler, J.D., 2011. *Heating, Ventilating, and Air Conditioning Analysis and Design.* 6th Ed. New York: John Wiley & Sons.
   3. T. H. Kuehn, J. W. Ramsey, J. L. Threlkeld, 1998. *Thermal Environmental Engineering.* New York: Pearson.

Prerequisites:

MAE 3524 –Thermal Systems Design OR MAE 3223 – Thermodynamics II and MAE 3233 – Heat and Mass Transfer. Graduate standing for 5080 section.

# Computer Software:

A non-linear equation solver with built-in thermodynamic properties will be used in this course. This computer program, called Engineering Equation Solver (EES), was developed by [F-Chart Software](http://www.fchart.com/) and is available to MechSE students. A user’s manual for the program is available on-line at [http://www.fchart.com/.](http://www.fchart.com/)

Access to the software is available for download from: <https://webstore.illinois.edu/shop/product.aspx?zpid=4039>

Note, a VPN is required to use this software off-campus. It is necessary to connect to the VPN with “Tunnel all” option to use off-campus. A VPN is not needed on campus.

# Course Materials:

Canvas will be the major means for distributing pre-lecture notes, homework, project, and midterm exam materials.

# Homework Assignments:

There will be periodic homework assignments for the semester and they will each be assigned at the end of select lectures. The problems are illustrative of the general material covered in class and of problems found on take-home exams. All homework problems are best solved using the EES program. Homework is collected electronically. **No late homework will be accepted**. Homework will not be accepted if the student misses class the day it is due, unless the student has prior permission from the instructor. When using EES, use comments and explanations frequently! If I cannot follow your thought process, you will not receive credit. It is acceptable to discuss the theory of assignments in groups but each student must submit work ***developed independently****.* Any form of academic dishonesty on a homework assignment will result in zero points on that homework.

# Office Hours:

Office Hours will be in-person with a virtual option via Teams. For virtual office hours, reach out to the TA/instructors that you wish to speak with directly using either the chat/call functions in Teams during the office hour timeslots. Students may also schedule appointments on an individual basis via e-mail ([crbrad@illinois.edu](mailto:crbrad@illinois.edu)) or Teams chat.

# Mid-term Exams:

There will be one mid-term, take-home, examination. Instructions with respect to this exam will be given out with the exams. Missing an exam without prior permission from the instructor will result in zero points on that exam. Any form of academic dishonesty on an exam will result in zero points on that exam.

# Semester Design/Research Project:

*Undergraduate section:*

There will be one, open-ended, design project which will be assigned during the second half of the semester. The project will leverage the tools and skills developed during the first half of the semester. The project will require the student to design a vapor compression refrigeration system for an application presented in the project description and account for design constraints provided including environmental, thermal comfort, regulatory, and any other stated constraint. The project will require a comprehensive, final report and summary presentation to be given to the class.

*Graduate section:*

There will be one, open-ended, project which will be assigned during the second half of the semester. The project will leverage the tools and skills developed during the first half of the semester. Additionally, the project will require additional research and skills development that may or may not be within the scope of the lecture material of course. The project will require a, comprehensive, final report and summary presentation to be given to the class

# Grading:

The course grade will be determined based upon the following distribution:

Homework problems 30%

Mid-Term Exams 40%

Project 30%

Based on personal criteria (attendance, homework, diligence), the instructor has the option of raising or lowering a border-line grade. Any form of repeated academic dishonesty will result in a failing grade.

# Changes to Syllabus:

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. The instructor will make announcements in-class and use e-mail communication to get information about changes in this course to students. It is the student’s responsibility to abide by the changes, once announced. If any change to the syllabus creates a conflict, it is the student’s responsibility to contact the instructor immediately regarding the conflict.

