Division of Engineering and Mathematics
School of Science, Technology, Engineering, and Mathematics
University of Washington Bothell

B ME 333 A Thermal Fluids III (SLN 10375)
Summer 2017

Time and Location: TTh 9:00 - 11:30 am in UW1 261

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Canvas Homepage: https://canvas.uw.edu/courses/1114741

Course Description

Thermal Fluids III covers the fundamentals of heat transfer and advanced topics in thermodynamics, picking up where Thermal Fluids I and II left off. Part I of the course begins with vapor and combined power cycles, and continues with refrigeration and air conditioning processes. The focus shifts to heat transfer in Part II. Topics include steady-state and transient conduction, free and forced convection, and heat exchangers.

Learning Outcomes

1. Analyze vapor power and refrigeration cycles, and describe how they work.
2. Use a psychrometric chart, in conjunction with mass and energy conservation principles, to analyze air conditioning processes and cooling towers.
3. Calculate thermal resistance and heat transfer by conduction under steady-state and transient conditions.
4. Calculate heat transfer coefficients and heat transfer rates in free and forced convection.
5. Design a heat exchanger to meet a specified need, and assess its performance.
6. Integrate thermal fluids principles in a design project that meets specified requirements.

ABET Learning Outcomes

(a) Apply knowledge of mathematics, science, and engineering.
(b) Design and conduct experiments, as well as analyze and interpret data.
(c) Design a system, component, or process to meet a desired need within realistic constraints.
(e) Identify, formulate, and solve engineering problems.
(k) Use the techniques, skills, and modern engineering tools necessary for engineering practice.

Assignments and Grading

Homework (10 %): Eight problem sets are assigned. Each set will be posted in Canvas approximately one week before it is due. The lowest grade will be dropped. In addition to the required problems, each set will list optional end-of-chapter problems that students should do on their own for additional practice. Homework is to be done by hand, in pencil, on green engineering paper, following the format from 331 and 332. Solutions will be posted after the homework has been collected. Homework will not be accepted after the due date.

In-class and Lab Activities (5 %): Three lab activities are planned: gas turbine demonstration, vapor compression refrigeration demonstration, and heat exchanger lab. The first two activities involve observing the operation of equipment and analyzing/interpreting the results. The heat exchanger lab requires carrying out a set of experiments, recording and analyzing the results. Instructions and worksheets will be provided. Other activities may be assigned as time permits.

Two mid-term exams (25 % each) open book and notes, no computer. These exams consist of problems similar to the required homework and optional practice problems. If you do not own the textbooks, you will need to make copies of relevant chapters/pages, or write down in your notes all the equations and data you think you will need. Only calculators approved by the National Council of Examiners for Engineering and Surveying (NCEES) for use on the Fundamentals of Engineering Exam are permissible for use on these exams. See the following link for the approved calculator models: **http://ncees.org/exams/calculator/**

Final exam (20 %), closed book. The final exam, two hours in length, will be given on the last day of class. This exam is comprehensive, the format multiple choice and similar to that of the Fundamentals of Engineering (FE) Exam. It is designed to test understanding of concepts, ability to read charts and tables efficiently, and proficiency in performing basic calculations. You are allowed to use the *FE Reference Handbook*, Version 9.4, as a resource for the exam. You can purchase the handbook (which is required in B ME 482), or download it for free from NCEES as a pdf document, at this URL, after setting up an account:
https://account.ncees.org/exam-prep/fe-reference-handbook-9-4-edition
However, for now *you will only need the "Thermodynamics" and "Heat Transfer" sections, which will be posted as pdf files in Canvas*. You should either print these out or purchase the handbook and bring it with you to class. To familiarize yourself with the notation and style of the handbook, I would encourage you to use it as much as possible as a resource throughout the course. The calculator policy is the same as it is for the mid-term exams.

Design project (15 %): Students will be formed into teams of 3 or 4 students and asked to choose a project scenario from a list of choices. Each team will propose a design solution to the problem as defined in the scenario. No more than two teams may work on any given scenario. The scenarios scope out real-world engineering design problems, including performance criteria and constraints. The solution will require some research, calculations, equipment and materials selection, and drawings. The results will be reported in an 8 - 12 page written report, word-processed, that provides background, rationale for the design, supporting calculations, drawings, and conclusions. Project teams will formed, and scenarios assigned, in the second week. The final report will be submitted in Canvas and in class on August 15.

Grading: Tests will be graded on a 100-point scale and converted to the 4-point scale using the following linear conversion: ≥95=4.0, 94=3.9, 93=3.8, 92=3.7, 91=3.6, 90=3.5,…,85=3.0,…, 80=2.5,…,65=1.0, 62=0.7 (lowest passing grade), ≤62=0.
In exceptional circumstances, grades may be curved using the appropriate statistical measures. Other assignments are graded directly on the 4-point scale. More information on the UW grading system can be found here:
http://www.washington.edu/students/gencat/front/Grading_Sys.html

Textbooks

1. Yunus A. Cengel and Michael A. Boles, *Thermodynamics: An Engineering Approach*, 8E (McGraw-Hill, 2014)
2. Theodore L. Bergman et al, *Introduction to Heat Transfer*, Sixth Edition (Wiley, 2011)

Expectations

1. All assigned reading should be completed before the day it appears on the schedule.
2. Lectures are intended to highlight main concepts and equations from the reading, present additional material when needed, and go over examples.
3. I often post notes in Canvas that correspond to the assigned reading. The notes are intended to complement, not replace, the reading.
4. Exams cover all assigned reading, lectures, classwork, and notes. Do not ask whether "X" will be on the exam if "X" was part of the assigned material. Assume that it will be on the exam unless it is otherwise made clear that it will not be on the exam.

Policies and Campus Resources

A list of policies and resources available to students can be found here:
http://www.uwb.edu/getattachment/stem/about/stem-policies/classroom-policies-stem-fc-1-12-17.pdf

Schedule[1]

Date	Topic/ Activity	Reading	Assignment Due
June 20	Vapor Power Cycles	Cengel, 10.1 - 10.6	
June 22	Cogeneration and Combined Cycles	Cengel, 10.8 - 10.9	
June 27	Refrigeration Cycles Gas Turbine Demo Group 1	Cengel, 11.1 - 11.4, 11.6 - 11.10	HW 1
June 29	Gas-Vapor Mixtures, Psychrometry Gas Turbine Demo Group 2	Cengel, 13.1, 14.1 - 14.5	HW 2
July 4	HOLIDAY - NO CLASS		
July 6	Air Conditioning and Cooling Towers Refrigeration Cycle Demo	Cengel, 14.6 - 14.7	
July 11	Finish Air Conditioning & Review Conduction 1D Steady State I	Bergman, 3.1.1 - 3.1.4 Bergmen, 3.3 - 3.4	HW 3
July 13	Conduction 1D Steady State II Midterm Exam 1	Bergman, 3.6	
July 18	Transient Conduction	Bergman, 5.1, 5.2, 5.4 - 5.6	HW 4
July 20	Introduction to Convection	Bergman, 6.1 - 6.8	
July 25	Heat Transfer in External Flow	Bergman, 7.1 - 7.6	HW 5
July 27	Heat Transfer in Internal Flow I	Bergman, 8.1 - 8.3	
Aug 1	Heat Transfer in Internal Flow II	Bergman, 8.4 - 8.6	HW 6
Aug 3	Heat Exchangers I Midterm Exam 2	Bergman, 11.1 - 11.3	
Aug 8	Heat Exchangers II Heat Exchanger Lab	Bergman, 11.4 - 11.5	HW 7
Aug 10	Free Convection Heat Exchanger Lab (if need to finish)	Bergman, 9.1 - 9.6	
Aug 15	Misc Topics, Review	TBA	Project Report
Aug 17	Final Exam		HW 8