Leonard C. Nelson College of Engineering & Sciences
Department of Mechanical Engineering

Course Objectives and Syllabus

Thermodynamics (MAE 320)
Spring 2017

Instructor

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Course Information

Class Hours: MWF 09:00 – 09:50
Location: ENGR-311
Number of Credit Hours: 3 hr credit
Course Format: 3 hr Lecture and 0 hr Laboratory
Prerequisites: MATH 156 or MATH 155 with instructor's consent

Compulsory Text

Fundamentals of Engineering Thermodynamics, 8th ed.
Moran, Michael J.; Shapiro, Howard N.; Boettner, Daisie D; Bailey, Margaret B.
WILEY, 2014

Web Sites

www.wiley.com/college/moran
community.wvu.edu/~bpbettig/MAE320
eCampus.wvu.edu

Related Texts and Recommended Reading

Thermodynamics and Chemistry, 2nd ed., Version 4
Howard DeVoe, 2012
Available online free by the author at:
http://www2.chem.umd.edu/thermobook/downloads.htm

DOE Fundamentals Handbook Thermodynamics, Heat Transfer, and Fluid Flow U.S. Department of Energy, 1992 Available online free by DOE at:
http://energy.gov/hss/downloads/doe-hdbk-10121-92

Fundamentals of Thermodynamics, 7th ed.
Borgnakke, Claus; Sonntag, Richard E.
John Wiley & Sons, Inc., 2009

Energy Systems, A New Approach to Engineering Thermodynamics, 1st ed.
Gicquel, Renaud
CRC Press, 2012

Thermodynamics and Heat Power, 7th ed.
Granet, Irving; Bluestein, Maurice
Pearson Prentice Hall , 2004

Course Objectives

This course deals with the fundamentals of Thermodynamics including thermodynamic systems and properties, relationships among the thermos-physical properties, the laws of thermodynamics and applications of these basic laws in thermodynamic systems. This course will provide the essential tools required to study thermodynamic systems in Applied Thermodynamics (MAE 321).

Expected Learning Outcomes

After successful completion of this course the students will be able to:

1. Explain fundamental concepts relevant to thermodynamics.
2. Explain the concepts of work, power, and heat in thermodynamics; determine work and heat sign conventions; determine work involved with moving boundary systems (graphical and analytical methods).
3. Explain the first law of thermodynamics for a closed system.
4. Perform energy analysis of refrigeration and heat pump thermodynamic cycles.
5. Determine thermodynamic properties of pure substances.
6. Apply the first law of thermodynamics for a control volume, including with turbines, compressors, nozzles, diffusers, heat exchangers, and throttling devices.
7. Explain the second law of thermodynamics, including why it is necessary, how it is defined (Kelvin-Planck and Clausius), the nature of irreversibility, and the Carnot cycle.
8. Explain the concept of entropy, including the Clausius Inequality, using thermodynamic tables, setting up entropy balances, and calculating isentropic efficiency of pumps, compressors, turbines, and heat exchangers.

Assessment

1. Homework

In order to encourage you to closely follow the material covered in the lectures and provide you with opportunities to practice the concepts taught in the class through problem solving, some problems will be assigned as homework assignments; some in the form of handouts or continuation of the class examples. It is strongly recommended that the assignments are completed independently. All assignments are due the next session unless another due date is announced by the instructor. The assignments will be collected, graded, and returned as soon as possible, particularly before the tests. They will count toward your final grade as indicated below. Half the homework points will be given for each problem seriously attempted; the other half will be based on successful solution of the problem. **Late homework will be accepted with 20% penalty per day unless there is a legitimate excuse.**

The purpose of homework in this course is also to develop skills in clearly, logically, and completely communicating problem-solving methodologies. Therefore:

- Each problem must have sections: “Given,” “Find,” “Assumptions,” and “Solution.” Sketches must be employed to illustrate the system in question, whenever the spatial relationships of quantities are not obvious.

- The units must be clear for every numeric value. Real values must have at least three significant digits for intermediate results to avoid excessive error accumulation due to truncation. Final answers must have significant digits that reflect the known precision of the solution.
- All computations must first show equations symbolically and then with numeric values, without any rearrangement of variables.
- Submitted work must be neat. Use a ruler and compass for diagrams; underline or put boxes around answers.
- Convince me you have the correct answer!

2. Quizzes Announced or unannounced quizzes may be given whenever it is found necessary. Make-up quizzes may be given for legitimate excuses if you contact me as soon as you return to the school.

3. Attendance Regular attendance is highly recommended. However, the records of your attendance will not be maintained. In case you have to miss a class, you are responsible for keeping up with the class work and being informed of all announcements made in the class concerning homework, quizzes, tests, etc. If you encounter difficulties of any kind, feel free to come and see me in my office.

4. Assignments Occasionally, assignments on topics of current interest will be assigned to provide you with opportunities to learn more about the applications of thermodynamics in your daily life. Usually, they will include reading of a recent scientific article and/or conducting background research and literature review on a specific topic. Also, some hands on experiments and/or software modeling will be assigned for this purpose. You will be asked to prepare a short report based on your research and/or participate in a class discussion. These may be either individual or small group exercises. You should follow the given instruction when preparing your reports.

5. Examinations Two term tests are scheduled. They will consist of a closed-book and closed-note section on concepts, definitions, and short exercises plus an open-book and closed-note section with numerical problems. You may use one-page, self-written formula sheet (without any solved problems) for your reference in the latter part of the tests. A final comprehensive examination will be given according to the school schedules based on the same format as the term tests. Make-up exams may be given for legitimate excuses if you contact the instructor as soon as you return to the school.

First term test: Friday February 17, 2017, 09:00 – 09:50
Second term test: Friday March 17, 2017, 09:00 – 09:50
Final comprehensive examination: Wednesday May 03, 2017, 08:00-09:50

6. Final Grades

Homework and Quizzes	10%
Assignments	20%
Class Tests	2×20%
Final Comprehensive Exam	30%
Total	100%

Letter grades are based on:

90 - 100%	A
80 - 89%	B

70 - 79%	C
60 - 69%	D
Less than 60%	F

Tentative Schedule

Introduction (1 period)
Concepts and definitions (4 periods)
Evaluation of work and heat transfer (3 periods)
First law of thermodynamics for a control mass (4 periods)
Properties of a pure substance (4 periods)
Ideal and real gases (2 period)
Term test 1 (1 period)
First law of thermodynamics for a control volume (3 periods)
First law of thermodynamics for various equipment (2 periods)
Carnot cycle (3 periods)
Second law of thermodynamics (4 periods)
Term test 2 (1 period)
Clausius inequality and entropy (2 periods)
Evaluation of entropy change and principle of increase of entropy (4 period)
Second law of thermodynamics for a control volume (3 period)
Efficiencies of turbines, compressors, nozzles, and diffusers (2 periods)
Final Exam (2 periods)