Course Syllabus for Engineering Fundamentals III: Thermodynamics 59:009
For the CIMBA Italy Offering, May-June2017

INSTRUCTOR: H. S. Udaykumar ("Uday"), Professor
Dept. of Mechanical and Industrial Engineering
2408 Seamans Center, The University of Iowa, Iowa City, IA-52242
ush@engineering.uiowa.edu

PRE-/CO-REQUISITES: 004:011/CHEM:1110 (P); 029:081/PHYS:1611 (P)
TEXTBOOK: Moran, M.J., Shapiro, H.N., Boettner, D.D., and Bailey, M.B., Fundamentals of Engineering Thermodynamics, 8th Edition, John Wiley and Sons, 2011.

COURSE OBJECTIVES:
1. Develop a basic understanding and knowledge of thermodynamics and its application to engineering,
2. Learn about energy and its conversion from one form to another,
3. Learn about properties of substances,
4. Learn the basic laws of thermodynamics and their applications, and
5. Develop a methodology for solving problems.

COURSE OUTLINE:
1. Introduction and Definitions
2. Energy, First Law of Thermodynamics
3. Properties
4. Control Volume Energy Analysis
5. Second Law of Thermodynamics
5. Entropy
6. Introduction to Power and Refrigeration Cycles

ATTENDANCE, ASSIGNMENTS AND EXAMINATIONS

Attendance at all classes and CIMBA sanctioned activities is MANDATORY. All unexcused absences will have the following consequences:

a. 1st absence will result in a loss of a 1/2 of a letter grade in that class
b. 2nd (cumulative) absence will result in a loss of an entire letter grade in that class
c. 3rd (cumulative) absence will result in a dismissal from the program

Absences due to illness require a note from the CIMBA Office Staff. If a student is sick and cannot attend class, he/she must inform the CIMBA Staff immediately. Failure to do so will result in an unexcused absence.

Three types of assignments will be given: homework, in-class problems, and in-class tests.

1. Homework will be assigned daily and must be done by each student individually (see below for misconduct policy).
2. Students will work in-class problems in teams during regular class time. These problems will be graded. Obviously, collaboration between team members is required for this type of assignment!
3. There will be in-class tests once each week to determine student progress. These test

problems must be done by each student individually.
No exams, quizzes or other tests are scheduled outside of class time.

GRADING PROCEDURES

The class will be graded using letter grades, with +/- modifications to the grades. The following table indicates the grades and the percentages (rounded to 0.1%) associated with each grade.

A+	96.7
A	93.3
A-	90.0
B+	86.7
B	83.3
B-	80.0
C+	76.7
C	73.3
C-	70.0
D+	66.7
D	63.3
D-	60.0

TENTATIVE CLASS SCHEDULE:

The schedule shown in APPENDIX A is based on four regular length class sessions each week (90 minutes in length) and one long class session each week (3 hours in length). Since the long session will be on a different day each week depending on the class rotation selected (A, B, or C) this schedule simply assumes six ninety minute sessions each week.

PROBLEM SOLUTION PROCEDURE:

The methodology outlined in the APPENDIX B will be used in this course. The use of this methodology will help you find the final solution in the quickest time with the minimum errors. To add incentive, this methodology must be followed when solving homework problems and exam questions to receive full credit. In addition, the consultation room personnel will ask to see your attempted solution when you approach them with a question, and will go over the methodology to see how far you have progressed.

Appendix A: Solution Methodology

Week #	Session #	Topic
1 **Intro to Energy, Work and Heat**	1	Introduction; Definitions (Chapter 1)
1	2	Definitions (Chapter 1); Work, Kinetic and Potential Energy, Heat (Chapter 2)
1	3	I law for Closed Systems, (Chapter 2)
1	4	Cycles (Chapter 2) Properties: States, p-v-T diagrams, phase changes, Data, Tables (Chapter 3)
1	5	Properties: States, p-v-T diagrams, phase changes, Data, Tables (Chapter 3)
1	6	In-Class Test
2 **The 1st Law**	1	Ideal Gas, Applications (Chapter 3)
2	2	Control volumes: Mass conservation; Energy conservation (Chapter 4)
2	3	Nozzle, Diffuser, Turbine, Compressor, Pump, Heat exchanger, throttle (Chapter 4)
2	4	Problems (Chapter 4)
2	5	Problems (Chapter 4)
2	6	In-Class Test
3 **The 2nd Law**	1	Irreversibility and the 2nd Law
3	2	Cycles: Carnot and Clausius statements
3	3	Entropy and changes in entropy
3	4	Internally reversible process; Closed systems
3	5	Open systems; Isentropic Process and Isentropic Efficiency
3	6	In-Class Test
4 **Cycles**	1	Rankine Cycle; Otto Cycle
4	2	Diesel Cycle; Brayton Cycle
4	3	Refrigerators and Heat Pumps
4	4	Solving Cycle Problems

4	5	Solving Cycle Problems
4	6	Review
4	Final	Final Exam

APPENDIX B: SOLUTION METHODOLOGY

KNOWN:
State problem briefly in your own words; do not repeat statement from text.

FIND:
Indicate what must be found.

THERMODYNAMIC SYSTEM AND PROCESS:
1. Sketch system
   a. Identify system boundaries by a dashed line and indicate whether it is a control mass or a control volume.
   b. Identify the Energy Transfer Processes (heat, work); draw arrows to indicate relevant processes and their assumed direction.
   c. Show system properties or conditions provided in problem statement on the sketch.

2. Sketch the thermodynamic process on the pertinent process diagram showing, if possible, the following items:
   a. Initial state
   b. Final state
   c. Process line(s)

ASSUMPTIONS:
List all pertinent simplifying assumptions.

PROPERTIES:
Compile property values needed for subsequent calculations and identify table from which they are obtained.

ANALYSIS:
1. Begin the analysis by introducing the relevant basic equations and then reducing them to their appropriate form based upon the stated assumptions.
2. Solve for the desired quantity. Note that when manipulating equations, it is better, easier, and faster to work with alphabetical characters.
3. Substitute numerical values and perform calculations to obtain desire results. Check units.
4. Clearly label your answer, with units, by a box. Report only significant digits. See your text for the proper unit abbreviations (e.g., MPa, kPa)

COMMENTS:
Carefully review your solution procedure and provide brief comments on the results. Some possible questions to answer are
1. What principles were involved?
2 . Based upon physical insight, check the following:

- Are the directions of heat and work correct?
- Is the magnitude of the quantity reasonable?
- Were the assumptions reasonable?

3 Are the results consistent with the process diagram?