ME 40 – THERMODYNAMICS

Spring 2016

Section: 1 (Control No. 55356; Final Exam: Group 7; May 10, 3-6 pm)
Lectures: M,W,F 10–11 am
Place: 50 Birge
Discussion: see bCourses

Instructor: Professor Michael Frenklach
Office: 6105B Etcheverry (Hours: see bCourses)
Phone: 643-1676; E-mail: **frenklach@berkeley.edu**
TAs: Claire Funke E-mail: **csfunke@berkeley.edu**
Zhenyuan Liu E-mail: **zhenyuan@berkeley.edu**
Office hours: see bCourses for schedule
Reader: Je Ir Ryu E-mail: **jryu@berkeley.edu**
Web site: https://bcourses.berkeley.edu/courses/1412503 (log in with your CalNet ID)

INTRODUCTION

This section of the course, while covering the fundamentals, will be based on the use of MATLAB. You will be provided with a set of m-functions that (a) calculate a requested state of matter, and (b) display the results in a graphical form. The homework will include writing your own m-files that perform calculations for different processes and devices.

You will need MATLAB (release 2009 or later) installed on the computer you will be using. The course m-files can be downloaded from bCourses. You should check periodically that site; it will contain updated m-files, instructions on their use, reported bugs, homework assignments, course announcements, etc, as well as a copy of this course outline.

If you have any questions or comments or just would like to share you thoughts, please come to see me or send me an e-mail. If you cannot make the office hours, I will be glad to make another time, in which case please send me an e-mail, give me a call, or let me know of your time preference before or after the class.

COURSE OUTLINE

I. Mathematical Preliminaries (Beginning of Chapter 12; pp. 661–666)

Partial derivatives
Relationships between derivatives
Exact differential

II. Basic Definitions and Concepts (Chapter 1)

System, Boundary, Environment, etc
State and state function
Equilibrium
Pressure and Temperature
Zeroth Law of thermodynamics

III. Properties of Pure Substances (Chapter 3)

Pure substance
Property diagrams and tables
Equation of state
The virial expansion
Ideal gas
Other equations of state

IV. The First Law of Thermodynamics (Chapter 2)

Reversibility
Work and heat
Internal energy and the First Law
Enthalpy
Heat capacities
Basic processes

V. The First Law for Ideal Gas (Chapters 3 and 4)

Isochoric, isobaric, isothermal, and adiabatic processes

VI. The First Law for Open Systems (Chapter 5)

Control volume
Conservation of mass
Conservation of energy

VII. The Second Law of Thermodynamics (Chapters 6 and 7)

Entropy
Carnot cycle
Inequality of Clausius
Calculation of entropy changes

VIII. Power and Refrigeration Cycles

Gas power cycles (Chapter 9)
Vapor power cycles (Chapter 10)
Combined power cycles (Chapter 10)
Refrigeration cycles (Chapter 11)

IX. Thermodynamic Property Relations (Chapter 12)

Legendre transformation
Free energy functions
The Maxwell relations
Changes in thermodynamic properties

X. Additional Topics

Gas and gas-vapor mixtures (Chapter 13)
Reacting mixtures and combustion (Chapter 15)

TEXTBOOKS

Main: Y.A. Çengel and M.A. Boles, "Thermodynamics: An Engineering Approach," Eighth (or Seventh) Edition, McGraw Hill.

McGraw Hill site: `http://www.mhhe.com/cengel`

Supplementary: M. C. Potter and C. W. Somerton, "Thermodynamics for Engineers," Schaum's Outline, McGraw Hill.

GRADING

a) Homework assignments 20 %

2 midterm tests 40 % (20 % each)

Final exam 40 %

b) No exam or homework grades will be dropped

c) No make-up exams

d) All homeworks must be submitted as hard copies in the designated drop box. No electronic copies will be accepted. **All homeworks are due Mondays at noon**, unless otherwise instructed.

e) Late homeworks: You will receive one letter grade reduction for each day late. For example, an assignment that is graded at an 'A' but turned in two days late would receive a 'C'. Late homeworks are to be submitted in the designated drop box. You must email Je Ir Ryu, the grader, to notify him that you have submitted a late assignment. Otherwise, your assignment may not be collected on the day you submit it and you could incur greater loss to your grade.