

University Of California, Berkeley
Department of Mechanical Engineering

ME 40 – Thermodynamics (3 units)

Undergraduate Required

Syllabus

CATALOG DESCRIPTION

This course introduces the scientific principles that deal with energy conversion among different forms, such as heat, work, internal, electrical, and chemical energy. The physical science of heat and temperature, and their relations to energy and work, are analyzed on the basis of the four fundamental thermodynamic laws (zeroth, first, second, and third). These principles are applied to various practical systems, including heat engines, refrigeration cycles, air conditioning, and chemical reacting systems.

COURSE PREREQUISITES

Chemistry 1A, Mathematics 1B, Physics 7B, and Engineering 7

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Thermodynamics, an Engineering Approach, Y.A. Cengel and M.A. Boles, McGraw Hill, Eighth Edition, New York, 2015

COURSE OBJECTIVES

The objectives of this course are:

- 1) to provide the fundamental background of thermodynamics principles, and
- 2) to develop analytic ability in real-world engineering applications using thermodynamics principles.

DESIRED COURSE OUTCOMES

After completion of the course, students are expected to be capable of performing basic analysis of performance for energy systems using thermodynamics principles.

TOPICS COVERED

Conservation of energy; definitions of heat and work for a macroscopic system; system states; internal energy. thermodynamic properties of liquids and gases; phase equilibrium; First Law analysis for closed systems; enthalpy. First Law control volume analysis; applications. Introduction to the Second Law; the Carnot Cycle. Definition and interpretation of entropy; entropy change for substances; second law analysis of engineering systems; First and second law analysis of engineering systems. The Rankine cycle; Analysis of gas power cycles. Refrigeration cycles; Thermodynamic relations. Air/water vapor mixtures; psychrometrics. Introduction to HVAC component analysis. Thermodynamics of reactive mixtures.

A mathematically-rigorous approach based on multivariable calculus is used throughout.

CLASS/LABORATORY SCHEDULE

Three hours of lecture and one hour of discussion per week.

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

Thermodynamics is a basic science dealing with energy and it has long been an essential part of engineering practices. This course provides essential knowledge for students to develop professional skills needed for engineering practices.

RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

Grade will be based on two midterms (40%), homework problem sets (20%) and a final exam (40%)

SAMPLE OF WEEKLY AGENDA

Week 1	Introduction & Basic Concepts, Energy
Week 2	Energy Transfer, General Energy Analysis
Week 3	Properties of Pure Substances
Week 4	Energy Analysis of Closed Systems
Week 5	Mass and Energy Analysis of Control Volumes
Week 6	Second Law of Thermodynamics
Week 7	Entropy
Week 8	Gas Power Cycles
Week 9	Vapor & Combined Power Cycles
Week 10	Refrigeration Cycles
Week 11	Thermodynamic Property Relations
Week 12	Gas Mixtures
Week 13	Air-Conditioning
Week 14	Chemical Reactions
Week 15	RRR
Week 16	Finals Week

ADDITIONAL COMMENTS/CONCERNS

PERSON(S) WHO PREPARED THIS DESCRIPTION

J-Y Chen, January 8, 2019, C Dames, February 20, 2019

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): [THERMODYNAMICS]

TIE CODE: LECS

GRADING: Letter and/or P/NP

SEMESTER OFFERED: Fall and/or Spring

COURSES THAT WILL RESTRICT CREDIT:

INSTRUCTORS: Van Carey, J-Y Chen, Chris Dames, Michael Frenklach, Carlos Fernandez-Pello, Costas Grigoropoulos

DURATION OF COURSE: 15 Weeks

EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 9

IS COURSE REPEATABLE FOR CREDIT? No

CROSSLIST: None