ME 311 Thermodynamics I

ME 311 - Thermodynamics I (3-0-3)
Prerequisites: Math 211 –, Phys 111
Reason for prerequisites: Successful understanding and quantification of engineering applications requires proper knowledge of basic principles of physics and mathematics

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Weekly listing of topics (15-week schedule)

Week	Topic	Chapter
1	Basic concepts	1
2	Energy analysis	2
	Quiz 1	
3-4	Properties of pure substances	3
5	Closed systems	4
	Quiz 2	
6-7	Open systems	5
8-10	Entropy	7
	Quiz 3	14
11-12	The second law	6
13	Exergy	8
14	Review	
15	Final Exam	

Course description

Thermodynamics is a basic science that deals with the application of the First and the Second laws of thermodynamics to various physical systems. The course focuses on the content and the physical meaning of these laws as well as their applications to the systems description. Analysis of the main energy conversion systems is used to illustrate the applications of the thermodynamic laws. The course combines (50%) lectures and (50%) problem-solving to provide students with

- Understanding and ability to use databases describing materials properties
- Understanding and ability to use the main thermodynamic functions
- Ability to apply the balance equations to the description of engineering systems
- Ability to evaluate and to improve efficiency of engineering systems
- Ability to communicate effectively the acquired knowledge

The course objectives

- To identify the fundamental concepts of thermodynamics
- To develop ability to apply thermodynamic functions to description and improvement of engineering systems
- To develop ability to apply databases representing material properties to description of engineering systems
- To introduce the basic knowledge of main energy conversion technologies.

Course outline

- Basic Concepts
  - The content of Thermodynamics
  - Thermodynamic systems
  - Systems Properties
  - Thermodynamic processes
  - Thermodynamic state and process (constitutive) equations
  - Units &dimensions
- Energy Analysis
  - Heat and Work
  - Forms of Work
  - Energy Function
  - The First Law
- Properties of Pure Substance
  - Description of a pure substance
  - Phase diagram
  - Properties tables
  - Ideal gas equation
- Analysis of a closed system
  - Polytropic processes
  - Energy balance
  - Enthalpy function
  - Specific heat
- Analysis of the open system
  - Conservation of Mass
  - Flow work
  - Energy analysis of the steady flow systems
  - Energy conversion devices
  - Unsteady systems
- Entropy
  - Entropy function
  - Entropy change
  - Isentropic processes
  - Reversible steady flow work
  - Entropy balance
  - Isentropic efficiency
  - The Second law
    - The Second law
    - Reversible and irreversible processes
    - Heat machine
    - Thermal efficiency
    - Carnot cycle
    - Thermodynamic temperature
  - Exergy
    - Exergy function
    - Reversible work and
    - Exergy balance
    - Second law efficiency

Required textbook

Yunus A. Cengel and Michael A. Boles. THERMODYNAMICS: An Engineering Approach , 5th Edition, McGraw-Hill, NY, 2005, ISBN 0-07-288495-9

Homework assignment

- Homework is issued at every lecture and due the following lecture
- Homework report is collected at the beginning of the lecture
- Late homework report will not be accepted for grading

Homework format guidelines

- Structure the solution into the following sections:

  Known - The problem is posed
  Find - The quantities to be found are stated
  Sketch - The physical situation and/or diagram
  Assumptions – The significant assumptions in solving the problem are stated
  Properties - The materials properties needed to solve the problem are listed
  Analysis - The problem is solved in a systematic manner, showing all steps, the fundamental equations from which the calculation begins are included, and all numerical values (including units) are shown
  Discussion - Comments are made on the results, as appropriate
- Arrange problems in numerical order
- Staple all pages together
- Print your name at the top of each page
- Write only on of 8½ x11 inch paper; start each problem on a new page

Homework grading

- Feedback on the homework will be provided during lectures, solutions will be discussed, and graded homework will be returned
- Each problem will be graded individually.

Quizzes and final exam

- The closed-book quizzes will be given on the third, sixth and tenth weeks since the beginning of the semester. Exact date of each quiz will be announced a week before the quiz.
- There will be a closed-book final exam during Finals' week, covering all of the course materials.
- Students may bring one two-sided sheet of notes to the quizzes and the final exam. The quizzes and the final exam must be completed individually, in accordance with the NJIT Honor Code.
- Each problem of the quizzes and the final exam will be graded individually.

A missed quiz will be averaged into the final grade as *zero*, unless an excuse is obtained in advance. Excuses are granted only for very serious circumstances attested to by the NJIT administration, verifiable and significant medical problems, religious holidays, and also serious personal situations, such as deaths in the family. A student who has been excused will be required to take a makeup exam.

Assessment criteria and grading

The course has been designed so that lectures, homework assignments, quizzes, and final exam are integral and essential parts of the learning process. Final grades will be determined from scores as follows:

Quiz 1, Quiz II and Quiz III: 15% each, *Homework: 30%* *Final Exam: 25%*

The final grade will be assigned on the basis of "*a curve*".

The NJIT Honor Code and Professional Conduct will be strictly enforced.

(F05)