ME 2234 – Applied Thermodynamics

Credits and Contact Hours: 3 Credits. Three 50 minute or two 75 minute lectures per week.

Instructors: Brice Cassenti, Baki Cetegen, Kamal Kumar, Ugur Pasaogullari, Michael Renfro, Chih-Jen Sung

Textbook: *Fundamentals of Engineering Thermodynamics*, 7th edition, by M.J. Moran, H.N. Shapiro, D.D. Boettner, and M.B. Bailey, John Wiley & Sons, 2011.

Specific Course Information:

a. Catalog Description: Thermodynamic first and second law analysis of vapor and gas cycles, property relations for simple pure substances, properties of ideal gas mixtures, psychrometry, fundamentals of combustion thermodynamics, application of thermodynamics in the design of thermal engineering systems.

b. Prerequisites: ME 2233 or CHEG 2111

c. Required, Elective or Selected Elective: Required

Specific Goals:

a. Course Outcomes:

After completing ME 2234 students should be able to:

1. Understand the components and basic assumptions for the Rankine cycle with and without cycle modifications
2. Understand the components and basic assumptions for the vapor-compression refrigeration system
3. Understand the components and basic assumptions for the Brayton, Otto and Diesel cycle
4. Compute energy and entropy balances for each component through a cycle to determine unknown items for the cycle as a whole
5. Compute thermodynamic properties for mixtures
6. Compute stoichiometric balances and equivalence ratios
7. Perform an energy balance for a reacting system

b. Relationship of Course Outcomes to Criterion 3 Student Outcomes:

a) an ability to apply knowledge of mathematics, science, and engineering: *Students acquire the skills to apply the laws of thermodynamics in mathematical form for the solution and optimization of thermal engineering systems.*

b) an ability to design and conduct experiments, as well as analyze and interpret data: *not applicable*

c) an ability to design a system, component, or process to meet desired needs: *Students gain design skills through assigned Design Project work.*

d) an ability to function on multi-disciplinary teams: *Students gain team experience working in their Design Project groups.*

e) an ability to identify, formulate, and solve engineering problems:

Students learn to identify, formulate, and solve engineering problems using the basic principles of thermodynamics.

f) an understanding of professional and ethical responsibility: *not applicable*

g) an ability to communicate effectively:
Students gain experience in written communication through the Design Project report.

h) the broad education necessary to understand the impact of engineering solutions in a global and societal context:
Students learn about the importance of efficient energy utilization from a perspective of limited energy resources (optimization of system efficiency) as well as the pollution prevention aspect (combustion and air pollution).

i) a recognition of the need for, and an ability to engage in life-long learning: *not applicable*

j) a knowledge of contemporary issues:
Students obtain a knowledge of contemporary issues through the design of internal combustion engines (with consideration of pollution aspects), aircraft engines, and land based gas turbine engines.

k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice:
Students learn to use analysis techniques and methods to solve problems in thermodynamics (and where applicable the integration of different subjects) in the design and optimization of thermal systems.

Topics Covered:

- Vapor power systems: Rankine cycle
- Vapor power systems: superheat and reheat
- Refrigeration and heat pump systems
- Gas power systems
- Thermodynamic relations for simple compressible substances
- Non-reacting gas mixtures
- Psychrometry
- Reacting gas mixtures and combustion