

EMCH 394 Applied Thermodynamics

Catalog Course Description:

EMCH 394 - Applied Thermodynamics. (3) (Prereq: EMCH 290, EMCH 201) Vapor and gas power cycles; refrigeration and heat pump systems, thermodynamic relations, ideal gas mixtures, psychrometrics and humid air analysis; combustion processes.

Prerequisite(s):

EMCH 290, EMCH 201

Textbook(s) and/or Other Required Material:

1. Fundamentals of Engineering Thermodynamics, 5th Edition, M. J. Moran and H. N. Shapiro, John Wiley & Sons, New York City, 2004.

Course Objectives: {Assessment Methods shown in Braces}

1. Students will demonstrate the ability to perform power cycle analysis using various working fluids. {1, 2, 3, 4}
2. Students will demonstrate the ability to perform analysis of refrigeration and heat pump cycles using various working fluids. {1, 2, 3, 4}
3. Students will demonstrate an understanding of the construction of thermodynamic property tables and the capability to determine changes in enthalpy, entropy and internal energy using a suitable equation of state. {1, 2, 3}
4. Students will demonstrate the ability to perform analysis of thermodynamic systems and cycles and to perform appropriate calculations where ideal gas mixtures are the working fluid. {1, 2, 3}
5. Students will demonstrate the ability to apply psychrometrics to analysis of heating, drying and air conditioning systems. {1, 2, 3, 4}
6. Students will demonstrate the ability apply the first and second laws to combustion processes. {1, 2, 3}
7. Students will demonstrate the ability to perform thermodynamic analysis of realistic problems using the Engineering Equation Solver (EES) software package. {1, 3, 4}

Topics Covered:

1. Rankine cycle including reheat and regenerative cycles. Otto, Diesel and Brayton air standard cycles. Vapor compression refrigeration and heat pump cycles.
2. Equations of state. Thermodynamic relations for internal energy, enthalpy and entropy. Generalized charts.
3. Mixtures of ideal gases. Psychrometrics and air conditioning processes.
4. First and second law applied to combustion processes. Chemical availability.

Assessment Methods

1. Homework
2. Written tests
3. Computer-based exams
4. Project

Class/Laboratory Schedule:

Lecture: Three 50-minute or two 75-minute sessions per week.
Recitation: Not applicable.
Laboratory: Not applicable.

Contribution of Course to Meeting the Professional Component:

Engineering Topics: 100%
Math and Science: 0%
General Education: 0%

Relationship of Course to Program Objectives:

The importance of each course objective to meeting the program outcomes is indicated with the following scale: 3 = major importance; 2 = moderate importance; 1 = minimal importance. Blank if not related.

Program Outcomes (see list for complete description)	Course Objectives						
	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
1.1. analyze, design and realize	3	3	3	3	3	3	3
1.2. computation techniques	2	2	3	2	3	2	3
1.3. design and interpret experiments							
1.4. apply linear algebra, calculus			3				
1.5. apply statistical methods							
1.6. understand chemistry and physics							
2.1. engineering economic analyses							
2.2. plan and execute projects							
2.3. oral and written communications							
2.4. professional responsibility							
2.5. multi-disciplinary teams							
2.6. life-long learning							

3.1. engineering in modern society							
3.2. literature, arts, humanities.							
3.3. foreign language							

Improvements and/or Modifications to the Course during the Last 5 Years:

In the past four years, we have introduced and integrated a software package, Engineering Equation Solver (EES) into this course. EES software is a very powerful tool for thermodynamic analysis with built-in functions for thermodynamic and transport properties, allowing students to efficiently explore the solution space for realistic problems, rather than manually solving idealized textbook problems. We have a site license in Mechanical Engineering that allows us to distribute EES to students for installation on laboratory and/or home machines. Additionally, this course was improved by including applied design projects and in-class group assignments. The projects and group assignments were favorably received by the students and gave them a practical interest in teamwork and applied thermodynamics. Early in the semester, students were divided into teams of three students. Each team worked together throughout the semester on in-class group problems and on a final project. Group problems were slightly more challenging than the individual homework problems. The students liked the integration of the engineering equation solver (EES) software into the course. The feedback from the students has been very positive as evidenced by the student course evaluations.

Person Who Prepared This Description and Date of Preparation:

Ed Young, 02/16/1999

Revised by Jeff Darabi, 02/14/2005