MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 315: Thermal Engineering Laboratory (1 credit): Required Course

Course Description (2008-2010 Catalog):

Laboratory studies related to heat transfer, thermodynamics, energy conversion, and HVAC applications.

Prerequisite Course: ME 311, ME 314, ME 380

Prerequisite by Topic:

- Engineering Thermodynamics I
- Introduction to Heat Transfer
- Fluid Dynamics for Mechanical Engineers

Textbook: (1) H. W. Coleman and W.G. Steele, "Experimentation and Uncertainty Analysis for Engineers," 1989, John Wiley & Sons, Inc. (Recommended) (2) Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, and Adrienne S. Lavine, "Fundamentals of Heat and Mass Transfer," 6th. Edition, 2007, John Wiley & Sons, Inc. (or equivalent reference) (3) Moran and Shapiro, "Fundamentals of Engineering Thermodynamics," 6th Edition, 2008, John Wiley & Sons, Inc. (or equivalent reference) (4) Robert W. Fox, Philip J. Pritchard, Alan T. McDonald, "Introduction to Fluid Mechanics," 7th Edition, 2009, John Wiley & Sons, Inc. (or equivalent reference)

Other Reference Material: Laboratory handouts on each experimental and numerical exercise

Course Coordinator: Yi-Tung Chen, Professor

Course learning outcomes:

(a) Understand safety is always the first priority in the laboratory.
(b) Understand the properties or variables of what we measure and why we need to measure.
(c) Understand why discrepancies always exist between experimental and analytical results.
(d) Collect data from experiments and perform error analysis
(e) Able to identify the possible errors happened to experimental measurements.
(f) Apply the fundamental engineering knowledge learned from heat transfer, thermodynamics, and fluid mechanics classes to improve the experimental measurement.
(g) Learn experimental techniques necessary to study problems in heat transfer and thermodynamics.
(h) Learn how to make single and dual junction thermocouples and use it to measure temperature.
(i) Lear how to determine thermistor resistance using the Volt-ohm meter (VOM) and use it to measure temperature.
(j) Learn how to use infrared detector to measure temperature.
(k) Learn how to show a block diagram of the vapor compression refrigeration cycle indicating the state points from the experimental data.

(l) Learn how to draw T-s and P-h diagrams of the ideal vapor compression refrigeration cycle shown with the temperature and pressure identified from the experimental data.

(m) Learn how to put the actual operating states on the actual refrigerant P-h diagram and connect the states.

(n) Find the internal coefficient of performance for the actual internal cycle and find the external coefficient of performance for the cycle.

(o) Determine an overall energy balance for the vapor compression refrigeration cycle system from the externally measured data (the power into the compressor, the heat removed from the water in the evaporator, and the heat added to the water in the condenser).

(p) Measure the thermal conductivity for the different materials by using the Fourier's conduction law.

(q) Able to find the overall-heat-transfer-coefficient-area product (UA) by using either the LMTD or □-NYU approach from the heat exchanger experimental data.

(r) Determine the performance information for a heat exchanger mounted in the heat exchanger testing rig.

(s) Able to compare the theoretical and experimental results from the Joule-Thomson throttling process.

(t) Learn how to apply the finite difference method to analyze the temperature distribution in a fin-type heat rejection unit on the electronic device.

(u) Compare analytical solution with numerical solution and identify the discrepancy reasons between two results.

(v) Learn how to write good formal laboratory report from the experimental results.

(w) Lean the value of honesty and lifelong learning from performing the experimental works.

Relationship of Course to Mechanical Engineering Program Educational Outcomes:

Goal1: Provide mechanical engineering graduates with technical capabilities.					Goal 2: Prepare the mechanical engineering graduates to have effective workplace skills.				Goal 3: Instilling a sense of responsibility as a professional member of society.			
1.a	**1.b**	**1.c**	**1.d**	**1.e**	**2.a**	**2.b**	**2.c**	**2.d**	**3.a**	**3.b**	**3.c**	**3.d**
H	**H**	**L**	**H**	**H**	**H**			**M**	**H**		**L**	

(L)ow (M)edium (H)igh

Topics Covered:

1. Laboratory safety
2. What do we measure? And why?
3. Discrepancies exist between analytical and experimental results
4. Why are calibrations of instruments needed?
5. Data collection and error analysis such as uncertainty analysis, mean value, standard deviation, confidence interval, propagation of uncertainty.
6. How to improve the experimental measurement such as applying good insulator for heat loss etc.
7. How to write good laboratory report

8. Measure temperatures using glass thermometers, thermocouples, thermistors, and infrared detector
9. Vapor compression refrigeration cycle, P-h diagram, and the coefficient of performance
10. Measurement of thermal conductivities on different materials
11. Shell-and-tube heat exchanger, LMTD, and □-NYU approaches to find UA
12. Joule-Thomson throttling
13. Introduction of numerical analysis

Laboratory Projects: (1) Temperature measurement (2) Vapor Compression Refrigeration (3) Thermal Conductivity Measurement (4) Heat Exchanger Evaluation (5) Joule-Thomson Throttling (6) Numerical analysis of heat transfer

Class/Laboratory Schedule: 90 minutes introduction and general information of thermal engineering laboratory, 170 minutes of experimental exercise in every other week, 90 minutes introduction of numerical analysis on heat transfer problem

Assessment of Student Progress toward Course Objectives

Five experimental and one numerical exercises, total of six formal laboratory reports

Class/Laboratory Schedule: F 1:00-3:50 PM and 4:00-6:50 PM (Fall Semester)

Contribution of Course for meeting Professional Component:

(a) Mathematics and basic sciences: 0 credit
(b) Engineering Topics (Design/Science): 1 credit
(c) General Education: 0 credit
(d) Others: 0 credits

Prepared By: Yi-Tung Chen

Date: October 1, 2009