Engineering Technology –MET Option

Course Number and Name: ET 306L, Thermodynamics Laboratory

Credits & Contact Hours: 1cr., one weekly laboratory session of 2.5 hours. Total semester contact hours are approximately 40.

Instructor's name: Craig Ricketts

Textbook *title*, author, and year: *Thermodynamics - An Engineering Approach*, Çengel, Y. A. and Boles, M. A., 2008.

Supplemental materials: *Virtual Experiments in Food Processing*, Singh, R. P. and Erdogdu, 2009; *CyclePad*, a shareware application for cycle analysis; and *Engineering Equation Solver, (EES)* of F-Chart Software.

Specific Course Information:

a. **Course Catalog Description** – Applications of thermodynamic theory to lab devices. Practice in testing, data collection, and instrumentation.
b. **Prerequisites** – ET 190 Applied Circuits and ET 191 Applied Circuits Laboratory.
c. **Corequisite** – ET 306 Fundamental and Applied Thermodynamics.
d. **Augmenting** – This is a required course in the MET curriculum.

Course Goals and Objectives:

Students acquire practical exposure to the fundamental concepts, experimental methods, and instrumentation encountered in applied thermodynamic processes. Also, students become familiar with the development and application of procedures for laboratory work and for the acquisition, processing, evaluation, and presentation of experimental data. Additionally, students gain experience in the preparation of well-organized technical reports and oral presentations that are accurate, comprehensive, and concise.

Related ABET Outcomes:

The **following** are the MET (x.) and ABET student outcomes that directly relate to Criterion 3. *An ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline;* to include:

(1.) **Algebra**, trigonometry, Boolean mathematics, calculus, statistics and probability, **fundamental principles and concepts of science and engineering technology**, **good practice in problem solving**, and **methods of standard practice in the analysis** and applied design **of mechanical systems**.
Also ABET 3.a., 3b, 3.c., 3.e, 3.g., and 3.k.

(2.) **Fundamental aspects of** AC and **DC circuits**, **electrical components**, computer programming logic, instrumentation principles, **experimental techniques**, and **methods of standard practice**, **safety consciousness**, **critical thinking skills**, and **codes and standards** in the **testing** and **evaluation** of **mechanical systems**.

Also ABET 3.a., 3b, 3.c., 3.e, 3.g., and 3.k.

(3.) **Current software corresponding to good practice in the application of mechanical engineering technologies. Software application functions to include: word processing**, **spreadsheet calculations**, **graphing**, **presentation media**, computer assisted drafting and manufacturing, manufacturing processes, **statistics**, **data acquisition**, project management, and the **analysis** and applied design **of systems involving** mechanisms, machines, or **fluid and thermal processes**.
Also ABET 3.a., 3b, 3.c., 3.g., and 3.k.

Course topics and lab session hours devoted to each topic:

Topics	**Lab Hours**
· Introduction: laboratory overview, relevance, and significance	1
· Safety in laboratory practice	3
· Professional ethics: a case study in how to proceed as a whistleblower in reporting of ethical lapses in industrial practice	2
· Use of codes and standards in practice	1
· Good practice guidelines for an employment search	1
· Good practice in the graphing of experimental data for technical reports	1
· Application of sample statistics in the evaluation of experimental data	1
· Application of error analysis in the planning of an experiment	1
· Thermodynamic properties, units and basic definitions; review of in practice	2
· Data acquisition techniques using TI graphing calculators	2
· Sensors types for temperature measurements	2
· Fundamental principles of temperature measurement	2
· Temperature sensor calibration in practice	2
· Use of fixed thermodynamic states in the calibration of temperature sensors	2
· Concept of simple-substance specific heat and practical applications	2
· Application of an IC-engine dynamometer in practice	2
· Concepts of torque, power, efficiency, and specific fuel economy as IC-engine performance characteristics	2
· Spreadsheet-based calculation of IC-engine performance characteristics	2
· Concept and application of the time constant in temperature measurement	3
· Concept of the latent heat of fusion and related application of the *T-h* diagram	3
· Use of an Hg barometer and corrections to readings of atmospheric pressure	1
· Application of software in cycle analysis	3
· Exposure to industrial-scale components such as pumps, heat exchangers, absorption refrigeration components, thermal energy storage pool, pipe and pipe fittings, gas turbine, vapor compression refrigeration system, measurement and control equipment, and utility tunnels; via a field trip to an on-campus co-generation plant.	2

Laboratory Exercises: typical topics for five cycles, each of two consecutive lab periods (prelab exercise and laboratory report required):

Evaluation of the quantity of the useful amount of energy stored in a dry-cell battery (with digital ammeter and voltmeter).

Calibration of handheld thermocouple ,thermistor, and RTD electronic thermometers (with Hg barometer, thermocouple, thermistor, RTD, and liquid-in-glass thermometers).

Determination of the latent heat of fusion for water (with thermocouple thermometer, analytical balance, triple-beam balance, and well-insulated vessel as an isolated system).

Determination of the time constants for temperature sensors (with graphing calculator-based data acquisition system, thermocouple, and bath of ice, or boiling water).

Determination of the performance characteristics of an internal combustion engine (with single-cylinder IC engine, dynamometer, remote-sensing tachometer, Hg barometer, and temperature sensors).

Determination of the COP of a thermoelectric refrigerator (with thermoelectric refrigerator, microcomputer-based data acquisition system, digital ammeter and voltmeter, and temperature sensors).

Other Typical Lab Assignments and Topics (1 lab period each):

Discussion of laboratory safety and requirements for prelab exercises and lab reports.

Exercise in professional ethics in practice as foundation for the development of professional ethics in the workplace (with video film, *The Case of the Challenger Disaster*). Concept worksheet required.

Exercise in the good practice of graphing experimental data (with microcomputer and graphing software package). Table of data and professional-quality graph required.

Exercise on use of a software application in cycle analysis. Worksheet printout required.

Field trip to co-generation plant on campus. Concept worksheet required.

Oral and Written Communication Requirements:

Students engage in discussions (led by instructor) during pre-lab and lab exercise sessions to share recommended techniques and procedures for relevant lab exercise. Students make individual oral presentation on an experimental topic in thermodynamics to lab section peers and instructor as an audience. All lab exercises require a laboratory exercise documentation sheet and a memorandum report.

Prepared by: Craig Ricketts **Date**: 12/20/10