RYERSON UNIVERSITY

Faculty of Engineering, Architecture and Science

Department of Mechanical and Industrial Engineering

Course Outline (F2012)

MEC514: Applied Thermodynamics

Instructor

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Prerequisites

MEC309, CPS125, MTH141, MEC222, MTL200, PCS211, and PCS213.

Compulsory Text

Fundamentals of Engineering Thermodynamics, *7th Edition*; Michael J. Moran and Howard N. Shapiro; Wiley, 2011.

Lab Manual

To be distributed via Blackboard

Calendar Description

Rankine cycle, steam turbine cycles, reheat and regenerative feed-water heating. Gas turbine cycles, regenerators. Combustion, stoichiometric, lean and rich mixtures. Nozzles. Convergent and convergent-divergent nozzles. Principles of vapour compression refrigeration cycles. Basic air-conditioning processes.

Learning Objectives

At the end of this course, the successful student will be able to:

1. (1c) Demonstrate and apply core engineering principles and concepts to solve engineering problems.
2. (2b) Formulate mathematical models using scientific and engineering principles.
3. (3b) Apply mathematical and scientific principles to predict behaviour of systems or processes.
4. (3c) Estimate errors, uncertainty, and sensitivity in measurement, instrumentation, and results.
5. (3d) Articulate the constraints and assumptions for the experiment.
6. (4a) Use technical knowledge, design methodology, and appropriate design tools and related resources.
7. (5b) Interpret results with regards to given assumptions and constraints, and how they relate to theoretical nature or system.
8. (6b) Manage own time and processes effectively to achieve personal and team goals.

9. (7d) Illustrate concepts in graphical form.
10. (10a) Follow ethical procedures when using skills and tools.
11. (11b) Plan tasks, allocate responsibilities, and set timelines to meet project goals.
12. (12a) Make accurate and appropriate use of technical literature and other information sources.

Note: Numbers in parentheses refer to the middle years attributes required by the Canadian Engineering Accreditation Board. For more information, see: http://www.feas.ryerson.ca/quality_assurance/accreditation.pdf

Course Organization

4 hours of lecture per week for 13 weeks, in 5 sections
2 hours of lab, alternate weeks for 3 labs
5 Lab/tutorial sections of maximum 24 students
5 Teaching Assistants, 1 section per TA

Course Evaluation

Midterm exam	20%
Group lab reports	10%
Group design project	25%
Final exam	45%
Total	100%

In order to pass the course, a student must:
(a) achieve an overall score for the course of 50% or higher AND
(b) pass either the midterm or the final.

Examinations

Midterm exam in Week 7, two hours, closed book (covers Topics 1 & 2).
Final exam, during exam period, three hours, closed book (covers Topics 3-6).

Course Content

Chap.	Sections	hours	Topic, description
8	8.1-8.5	16	**Topic 1. Steam Turbine Systems:** Rankine cycle. Mollier Chart. Rankine cycle with irreversibilities. Steam turbine isentropic efficiency. Rankine cycle with reheat and superheat. Rankine cycle with regenerative feed water heating.
9	9.5-9.8, 9.10	8	**Topic 2. Gas Turbine Systems:** Closed and open cycle gas turbines. Cold air-standard analysis. Gas turbine cycles with irreversibilities. Compressor and turbine isentropic efficiencies. Simple single shaft gas turbine. Gas turbine with free power turbine. Regenerative cycles. Introduction to *combined power cycles*.
12	12.1-12.4	4	**Topic 3a. Mixtures:** Non-reacting gas mixtures and property evaluation.
13	13.1-13.3	3	**Topic 3b. Combustion:** Reacting mixtures. Combustion of stoichiometric, rich, and lean mixtures. Exhaust gas analysis.
9	9.12-9.14	7	**Topic 4. Nozzles:** Introduction to compressible flow. Convergent and convergent-divergent nozzles.
10	10.1-10.3, 10.6	6	**Topic 5. Refrigeration & Heat Pumps:** Vapour compression cycles. *p-h* diagrams. Irreversible compression. Performance calculations. Heat pumps.
12	12.5-12.8	6	**Topic 6. Air Conditioning:** Psychrometric chart and analysis of basic psychrometric processes.

Laboratory/Tutorials

Lab	Title	Room
1	Steam Boiler & Turbine Test.	KHE27-29
2	Multi-load GM-6 Engine Test & Exhaust Gas Analysis.	KHE27-29
3	Heat Pump Test.	KHE27-29

Design Project:
There will be a mandatory design project component of this course. The project will be done in groups and worked on outside of formal lectures/labs. The members of a lab group will constitute a project group. Design projects are due on Friday, **November 23, 2012**.

Component	Item Due	Due Date	Marks
1	Planning Meeting Report	Tuesday, October 2, 2012	5
2	Progress Report	Friday, November 2, 2012	20
3	Final Report	Friday, November 25, 2012	75

Note that the final report due date is at the end of term week 12. According to Policy 145, Section 2.4.1, due dates after week 12 are not permitted. Therefore, no extensions can be granted.