FORT LEWIS COLLEGE
Department of Physics and Engineering

COURSE: ENGR 270 – Thermodynamics, 1:25 – 2:20 MWF, Rm 680 BH

TERM: Winter 2013

INSTRUCTOR: Dr. Laurie Williams
Office: 632 BH;   Office Hours: 10:10-11:05 MWF, 2:30 – 3:20 MW, 11:15-12:10 R
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COURSE OBJECTIVE: A first course in engineering thermodynamics. The course uses the macroscopic
approach with an emphasis on properties and thermodynamic systems. The overall objective is to
develop the ability to prepare energy and mass balances for various engineering systems and to develop
an understanding of the increase in entropy principle.

COURSE OUTCOMES (with corresponding FLC ABET Outcomes):
1. Describe the state of thermodynamic equilibrium both qualitatively and quantitatively through calculation
   of the thermodynamic properties of the system (Outcome 2 and 3).
2. Compute the change in the state of a closed thermodynamic system and heat and work transfer when the
   system goes through a process (Outcome 2 and 3).
3. Compute the change in state of the working substance in an open thermodynamic system and the related
   heat and work transfer rates when the system operates in steady state (Outcome 2 and 3).
4. Use Carnot cycle to estimate limiting performance of heat engines, refrigerators, and heat pumps
   (Outcome 2 and 3).
5. Apply First and Second laws of Thermodynamics in the description of the performance of power
   producing and consuming systems (Outcome 2 and 3).
6. Apply thermodynamic principles and techniques of analysis to the definition and solution of technically
   and socially significant problems (Outcome 1, 2, and 3).
7. Utilize textbook software for thermodynamic properties of substances (Outcome 6).
8. Prerequisite course for Thermal/Fluid Sciences Discipline Specific Depth (Outcome 4)

FLC ABET OUTCOMES:
(1) Our students will have experienced a core of humanities, social sciences, and communications and
    demonstrate the use of this core to support the technical content of their engineering curriculum.
(2) Our students will become competent in fundamental math/basic science subjects, which include:
    • Calculus through ordinary differential equations.
    • Chemistry and calculus based physics
    • Laboratory experiences in the physical sciences
(3) All graduating engineering students will be competent in a group of core engineering fundamentals.

    These include Computer Aided Design, Programming, Electric Networks, Statics, Dynamics,
    Thermodynamics, Measurements and Instrumentation, Mechanics of Materials, Material Science,
    Fluid Mechanics, and Computational Methods.
(4) Upper level engineering students will have had the opportunity to demonstrate depth in a discipline
    specific area and/or prepare themselves for graduate education.
(6) All engineering students will be laboratory and computer proficient with current laboratory and computer
    methods.

PREREQUISITES and EXPECTATIONS: Prerequisite courses include Math 221 and Phys 217. I expect each
student to attend all classes and complete all homework assignments. Be at class on time and turn in your
homework on time.

TEXTBOOK: R.E. Sonntag, C. Borgnakke, and G.J., Van Wylen, 2009, *Fundamentals of Thermodynamics*,
seventh edition, John Wiley.

CLASS PARTICIPATION: Learning engineering subjects can be a difficult task; it can only be done by working problems on your own. Your learning in this course will be a combination of textbook material, lecture material in-class discussion, and problem solving. Your active participation in class exercises and discussion is essential to your learning of the subject matter. Your own work in problem solving is a key to your mastery of the subject matter.

HOMEWORK: Weekly homework assignments will be assigned. These problem sets (for each previous week) are due at the beginning of class on Monday of each week.

ASSIGNMENTS: Course grades will be based on weekly quizzes, homework, one midterm, and the final exam.

CLASS SESSIONS: The course is organized into twelve subject matter units. Each unit will generally start on a Monday (following a 30-minute quiz), with a brief introductory lecture. The Wednesday class will complete the lecture for the unit of new material. Reading assignments for the new material are given in the course schedule below. These reading assignments should be completed before the lecture. The Friday class may have a brief lecture to answer student questions on the previous lecture and the homework, however most of the class time will be spent in group work, solving problems on the weekly topic. At the start of class on each Monday, there will be a 30-minute quiz. The quiz will be based on the assigned but uncollected homework problems and the in-class exercises from the previous week. Students are expected to spend a significant amount of time outside of class, doing the homework problems to prepare for quizzes. The first quiz will be on Monday, January 14th

GROUP WORK: In the group exercises, students will be assigned one or more problems to work on in small groups of three students. Each student should contribute to the group work to provide a mutual learning environment for the group. The group self-study sessions are intended to help you learn the course material and to make you more comfortable with working in groups, an important learning outcome of your engineering study. During group work, encourage all members in your group to participate. Answer questions your fellow students ask you, in a respectful manner (as you would like to have your questions answered when you ask.) If you are used to working alone, the group work may be a difficult experience for you at first, but learning to work with your colleagues is an especially important experience for your future engineering careers if you are not used to working with groups. During group work the instructor will not answer questions of individuals, only questions that the group has not been able to answer among themselves.

GRADING: Your grade in this course will be based on homework, weekly quizzes, a midterm exam, and a final exam. The assignment, quizzes, and exams will be weighted as follows in computing the final grade:

Homework	10%
Weekly quizzes	35%
Midterm Examination	25%
Final	30%

Only the ten highest quiz grades will be counted in computing the quiz grade for the semester. Students who take eleven or twelve quizzes will have their lowest grade or two lowest grades, respectively, removed before computing the quiz grade for the semester. The quiz grade for students who take ten or fewer ten quizzes will be calculated from the quizzes taken; there will be no make-up or adjustment for students who take fewer than ten quizzes.

NO MAKE-UP EXAMS: There are no make-up exams or quizzes. Students who miss the midterm exam will receive a calculated midterm grade, based on their performance on final exam and all the quizzes that they took. See the grading section above for the treatment of quiz grades.

WITHDRAWALS:
1) Withdrawals from the course may be made until January 22nd without a record.
2) Withdrawals beginning January 23rd require the instructor to assign a grade of "W" or "F".
3) After March 1st, no withdrawals (leaving the course with a "W") from the course are allowed.

CLASS POLICIES:
1) Fort Lewis College email is the official means of communication at the college. This means that you are responsible for checking your email. I will occasionally use email as a way of making class announcements. "I did not check my email," is not an excuse for missing an assignment or announcement.
2) Cell phone calls and text messaging is distracting and rude – neither will be tolerated during the designated class time. Please turn your phones off and put them away, failure to comply with this request may result in the professor asking you to leave the class and 5 points will be deducted from the week's homework assignment.

DEPARTMENT POLICIES: For policies on grading, syllabus changes, disputes with instructor, academic dishonesty, and other important issues see: Syllabus Policies (link on Moodle and faculty webpage, http://faculty.fortlewis.edu/Williams_l/).

SPECIAL NEEDS: Students with disabilities who require reasonable accommodations to fully participate in course activities or meet course requirements must register with Disability Services, 280 Noble Hall, 247-7459. If you qualify for services, bring your letter of accommodations to me as soon as possible.

CHANGES: Students are responsible for all changes to this outline announced in class.

Readings should be completed prior to the lecture.

Period	Date	Subject	Reading	Homework Problems
1M	1/7	Introductory comments, units. Concepts and Definitions	Chap 1, Chap 2	2.6, 2.40, 2.43, 2.62, 3.19, 3.26, 3.35, 3.57, 3.74, 3.87, 3.109
2W	1/9	Unit 1: Properties of pure substances and tables	Sect 3.1-3.7	
3F	1/11	Self learning on unit 1		
4M	1/14	**Quiz Unit 1,** start unit 2	Chap 4	4.12, 4.28, 4.37, 4.49, 4.56, 4.62, 4.67, 4.104
5W	1/16	Unit 2: Work and Heat		
6F	1/18	Self learning on unit 2		
7M	1/21	**Quiz Unit 2,** start unit 3	Sect 5.1 – 5.5	5.26, 5.29, 5.37, 5.40, 5.50, 5.66, 5.72
8W	1/23	Unit 3: Heat, Internal energy, and the first law of closed systems		
9F	1/25	Self learning on unit 3		
10M	1/28	**Quiz Unit 3,** start unit 4	Sect 5.6 – 5.9	5.81, 5.86, 5.94, 5.100, 5.106, 5.118, 5.124
11W	1/30	Unit 4: Specific heats, ideal gas properties, rate equations		
12F	2/1	Self learning on unit 4		
13M	2/4	**Quiz Unit 4,** start unit 5	Sect 6.1 – 6.4	6.11, 6.14, 6.26, 6.34, 6.40, 6.50, 6.58
14W	2/6	Unit 5: First law for open systems		
15F	2/8	Self learning on unit 5		
16M	2/11	**Quiz Unit 5,** start unit 6	Sect 6.4 – 6.5	6.70, 6.78, 6.83,

17W	2/13	Unit 6: First law for open systems		6.89, 6.94, 6.102, 6.105
18F	2/15	Self learning on unit 6		
19M	2/18	**Quiz Unit 6**		Review Problems
20W	2/20	**Review for midterm**		
21F	2/22	**Midterm exam**		
22M	2/25	Unit 7: Heat engines and the 2nd law of thermodynamics	Chap 7	7.5, 7.18, 7.33, 7.41, 7.44, 7.54, 7.62, 7.78, 7.94
23W	2/27	Unit 7: Heat engines and the 2nd law of thermodynamics		
24F	3/1	Self learning on Unit 7		
Spring Break 3/4 – 3/8				
25M	3/11	**Quiz Unit 7,** start unit 8	Sect 8.1 – 8.6	8.1, 8.19, 8.27, 8.35, 8.43, 8.48, 8.54, 8.60
26W	3/13	Unit 8: Entropy		
27F	3/15	Self learning on Unit 8		
28M	3/18	**Quiz Unit 8,** start unit 9	Sect 8.7 – 8.12	8.67, 8.74, 8.81, 8.91, 8.99, 8.110, 8.118, 8.161
29W	3/20	Unit 9: Entropy generation and the balance equation.		
30F	3/22	Self learning on Unit 9		
31M	3/25	**Quiz Unit 9,** start unit 10	Chap 9	9.3, 9.17, 9.28, 9.36, 9.38, 9.45, 9.60, 9.81, 9.93, 9.128
32W	3/27	Unit 10: 2nd law for open systems		
33F	3/29	Self learning on Unit 10		
34M	4/1	**Quiz Unit 10,** start unit 11	Sect 11.1 – 11.7	11.2, 11.15, 11.30, 11.34 11.41, 11.51, 11.59
35W	4/3	Unit 11: The Rankine Cycle		
36F	4/5	Self learning on Unit 11		
37M	4/8	**Quiz Unit 11,** start unit 12	Sect 12.1 – 12.10	12.15, 12.27, 12.38, 12.47, 12.61, 12.73, 12.95
38W	4/10	Unit 12: Brayton cycle, gas turbines, Air Power cycles		
39F	4/12	Self learning on Unit 12		
40M	4/15	**Quiz Unit 12**		To be announced
41W	4/17	Catch-up and unfinished business		
42F	4/19	**Review for Final**		
Final Cumulative Exam: Tuesday, 4/23/13, 9:45-11:45 am				