

FORT LEWIS COLLEGE
Department of Physics and Engineering

COURSE: ENGR 270 – Thermodynamics, 1:25 – 2:20 MWF, Rm 400 BH

TERM: Fall 2014

INSTRUCTOR: Dr. Laurie Williams

Office: 632 BH; Office Hours: 10:10-11:00 MWF, 2:30 – 3:20 MF, 11:00-11:50 R

Phone: (970) 247-7160

E-mail: williams_l@fortlewis.edu

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 ABET Outcomes):

1. Describe the state of thermodynamic equilibrium both qualitatively and quantitatively through calculation of the thermodynamic properties of the system (Outcomes a, e).
2. Compute the change in the state of a closed thermodynamic system and heat and work transfer when the system goes through a process (Outcomes a, e).
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 (Outcomes a, e).
4. Use Carnot cycle to estimate limiting performance of heat engines, refrigerators, and heat pumps (Outcomes a, e).
5. Apply First and Second laws of Thermodynamics in the description of the performance of power producing and consuming systems (Outcomes a, e).
6. Apply thermodynamic principles and techniques of analysis to the definition and solution of technically and socially significant problems (Outcomes a, e, h).
7. Prerequisite course for Thermal/Fluid Sciences Discipline Specific Depth (Outcome e)

ABET OUTCOMES:

- (a) Ability to apply knowledge of mathematics, science, and engineering
- (e) Ability to identify, formulate, and solve engineering problems
- (h) Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

TOPICS:

- Identifying thermodynamic properties
- Isolated, Closed, and Open thermodynamic systems
- Heat and Work
- Thermodynamic Cycles
- First and Second Laws of Thermo
- Thermodynamic Cycles

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, September 8th.

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.

GRADES:

Grades will be no worse than:

- >90 - A
- >80 - B
- >75 - C
- >60 - D
- <60 - F

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 September 16th without a record.
- 2) Withdrawals beginning September 17th require the instructor to assign a grade of "W" or "F".
- 3) **After October 24th, no withdrawals (leaving the course with a "W") from the course are allowed.**
- 4) **NEW FLC POLICY --** Up to 12 credits of Fort Lewis College courses with initial grades of C- or lower may be repeated at Fort Lewis College or another accredited institution for grade replacement.

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 - http://faculty.fortlewis.edu/Williams_1/).

SPECIAL NEEDS: Fort Lewis College is committed to providing all students a liberal arts education through a personalized learning environment. If you think you have or you do have a documented disability which will need reasonable academic accommodations, please contact, Dian Jenkins, the Director of Disability Services, 280 Noble Hall, 970-247-7459, and/or jenkins_d@fortlewis.edu for an appointment 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	9/1	Introductory comments, units. Concepts and Definitions	Chap 1, Chap 2	2.4, 2.37, 2.46, 2.52, 3.20, 3.27, 3.43, 3.62, 3.72, 3.85, 3.107
2W	9/3	Unit 1: Properties of pure substances and tables	Sect 3.1-3.7	
3F	9/5	Self learning on unit 1		
4M	9/8	Quiz Unit 1 , start unit 2	Chap 4	4.9, 4.29, 4.38, 4.47, 4.58, 4.61, 4.69, 4.103
5W	9/10	Unit 2: Work and Heat		
6F	9/12	Self learning on unit 2		
7M	9/15	Quiz Unit 2 , start unit 3	Sect 5.1 – 5.5	5.25, 5.31, 5.36, 5.43, 5.54, 5.61, 5.70
8W	9/17	Unit 3: Heat, Internal energy, and the first law of closed systems		
9F	9/19	Self learning on unit 3		
10M	9/22	Quiz Unit 3 , start unit 4	Sect 5.6 – 5.9	5.79, 5.83, 5.92, 5.101, 5.105, 5.118, 5.125
11W	9/24	Unit 4: Specific heats, ideal gas properties, rate equations		

12F	9/26	Self learning on unit 4		
13M	9/29	Quiz Unit 4 , start unit 5	Sect 6.1 – 6.4	6.7, 6.18, 6.28, 6.35, 6.42, 6.48, 6.53, 6.60
14W	10/1	Unit 5: First law for open systems		
15F	10/3	Self learning on unit 5		
16M	10/6	Quiz Unit 5 , start unit 6	Sect 6.4 – 6.5	6.71, 6.80, 6.85, 6.93, 6.103, 6.113
17W	10/8	Unit 6: First law for open systems		
18F	10/10	Self learning on unit 6		
19M	10/13	Quiz Unit 6		Review Problems
20W	10/15	Review for midterm		
21F	10/17	Midterm exam		
22M	10/20	Unit 7: Heat engines and the 2 nd law of thermodynamics	Chap 7	7.1, 7.17, 7.32, 7.38, 7.46, 7.54, 7.63, 7.79, 7.92
23W	10/22	Unit 7: Heat engines and the 2 nd law of thermodynamics		
24F	10/24	Self learning on Unit 7		
25M	10/27	Quiz Unit 7 , start unit 8	Sect 8.1 – 8.6	8.2, 8.18, 8.24, 8.38, 8.41, 8.47, 8.53, 8.61
26W	10/29	Unit 8: Entropy		
27F	10/31	Self learning on Unit 8		
28M	11/3	Quiz Unit 8 , start unit 9	Sect 8.7 – 8.12	8.68, 8.76, 8.92, 8.100, 8.111, 8.121, 8.159
29W	11/5	Unit 9: Entropy generation and the balance equation.		
30F	11/7	Self learning on Unit 9		
31M	11/10	Quiz Unit 9 , start unit 10	Chap 9	9.4, 9.16, 9.27, 9.35, 9.39, 9.46, 9.61, 9.79, 9.95, 9.127
32W	11/12	Unit 10: 2 nd law for open systems		
33F	11/14	Self learning on Unit 10		
34M	11/17	Quiz Unit 10 , start unit 11	Sect 11.1 – 11.7	11.3, 11.14, 11.29, 11.33, 11.43, 11.50, 11.60
35W	11/19	Unit 11: The Rankine Cycle		
36F	11/21	Self learning on Unit 11		
Thanksgiving Break 11/24 – 11/28				
37M	12/1	Quiz Unit 11 , start unit 12	Sect 12.1 – 12.10	12.14, 12.30, 12.38, 12.48, 12.63, 12.96
38W	12/3	Unit 12: Brayton cycle, gas turbines, Air Power cycles		
39F	12/5	Self learning on Unit 12		
40M	12/8	Quiz Unit 12		To be announced
41W	12/10	Catch-up and unfinished business		
42F	12/12	Review for Final		
Final Cumulative Exam: Tuesday, 12/16/12, 9:45-11:45 am				