ME 2234 Applied Thermodynamics  
Section 002 (Class Number 5360), Section 003 (Class Number 5361)  
Monday/Wednesday/Friday 8:00 – 8:50 a.m., United Technologies Engineering Building 175  

Syllabus, Spring 2015

Credits & contact hours: 3 credits. Three 50 minute lectures per week.

Instructor: Prof. Michael T. Pettes  
(Office: UTEB 354, Email: pettes@engr.uconn.edu)

Teaching assistants: Mr. Sajad Yazdani (Office: EII 309, Email: sajad.yazdani@uconn.edu)  
Mr. Eric Leamon (Office: EII 315, Email: eric.leamon@uconn.edu)

Time & place:  
Lecture: M/W/F 8:00 – 8:50 a.m., UTEB 175  
Instructor office hours: M/W 9:00 a.m. – 10:00 a.m., UTEB 354  
TA consultation hours: M 1:00 – 3:00 p.m., EII 315  
(TA’s will alternate weekly)

Web page: https://learn.uconn.edu/ (HuskyCT, login with NetID)

Course description: This course introduces thermodynamic first and second law analysis of vapor and gas cycles, property relations for simple pure substances, properties of ideal gas mixtures, psychrometry, fundamentals of combustion thermodynamics, and application of thermodynamics in the design of thermal engineering systems.

Prerequisites: ME 2233 Thermodynamic Principles or CHEG 2111 Chemical Engineering Thermodynamics I.


Active learning technology (required): Students will also need an *clicker2* from the UConn Co-op and can learn more about these at the Institute for Teaching and Learning website http://clickers.uconn.edu/clicking-at-uconn-fyi/.

Grading:  
<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>10 %</td>
</tr>
<tr>
<td>Class participation</td>
<td>15 %</td>
</tr>
<tr>
<td>Team Design Project</td>
<td>10 %</td>
</tr>
<tr>
<td>Midterm exam 1</td>
<td>15 %</td>
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<tr>
<td>Midterm exam 2</td>
<td>20 %</td>
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<tr>
<td>Final exam</td>
<td>30 %</td>
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<tr>
<td>Bonus Credit</td>
<td>3.33 %</td>
</tr>
</tbody>
</table>

Important dates:  
February 2: Last day to add or drop courses without additional signatures. Courses dropped after this date will have a "W" for withdrawal recorded on the academic record.  
March 30: Last day to drop a course.
**Reading and lectures:** Students are responsible for the assigned material from the course text, whether covered in class or not. Regular attendance is expected. Lectures are designed to help students with learning course material and solving homework problems. Material should be read prior to lectures.

**Special events:** Students are encouraged to attend special events by experts visiting UConn noted in this syllabus. Bonus points of 3.33% for each event will be added to the final grade. In order to receive credit, students must attend the seminar and write a brief (roughly one page) report with three sections discussing (i) the motivations for the speaker’s research (including significant experiments or theories cited by the speaker) (ii) significant contributions made by the speaker, and (iii) remaining challenges or new research areas proposed by the speaker.

**Class participation:** *i>clicker* classroom response systems will be used during each lecture for informal feedback and for small problems. Problems will be aimed at testing the material from the reading and from the lectures. It is important that students acquire a clicker as soon as possible and register the clicker in HuskyCT. The two lowest quiz-day grades will be dropped from the final class participation grade. Class participation also consists of attendance to the UConn Co-Generation Power Plant site visit (5% of the course grade). Safety requires you wear long pants and closed-toe shoes for the tour.

**Homework:** Weekly homework assignments will be due at the beginning of each Wednesday lecture and will be graded on the demonstrated level of effort, except for weeks when exams are scheduled. Late homework will not be accepted. Solutions will be posted on the website (HuskyCT). You must follow the problem solution format described on page 24 in Moran & Shapiro to obtain full credit. Homework can be obtained from the TA’s beginning the following Wednesday afternoon (outside room EII 309). The two lowest homework grades will be dropped from the final grade.

*Moran & Shapiro Section 1.9, p. 24: Standard format for homework problems:*

Work should be neat, well organized, and easy to follow. Students are expected to follow this standard format for completing problems. Points will be deducted for work that does not adhere to this format.

1. Use 8.5×11 inch paper for problems. Only one side should be used.

2. Follow Section 1.9, p. 24 in Moran & Shapiro. Explicitly label sections: Known, Find, Schematic and Given Data, Engineering Model, Analysis. The problem statement is needed before the solution; a drawing is usually required.

3. No credit will be given for final answers that do not show work involved.

4. Draw a box around your answers. ALWAYS include units.

5. The top of each page should contain the following information from left to right:

   Your last name, first name | ME 2234, Section 00# | Assignment # | Page #/Total pages

6. Staple all pages of an assignment together in the upper left corner.

**Team design project:** The design project will enable small groups of students to work on an optimization problem requiring the use of advanced software. Students will utilize the software of their choice (*MATLAB*, *Mathematica*, or the *IT* software included with Moran & Shapiro). The topic will
integrate ideas learned in the course as well as practical concerns exhibited by the power plant site visit. The design project statement and group assignments are attached to the syllabus.

**Exams:** Exams will include two mid-terms, as well as a comprehensive final exam. Exams are closed book with one double-sided notes sheet allowed (to be stapled to exam) as well as a calculator. No other material or technologies are allowed. Make-up exams may be scheduled prior to final examinations for students who were previously excused from one of the mid-term exams due to a verifiable illness or other officially documented circumstance.

**Regrading policy:** Regrade requests must be submitted in writing on a separate sheet of paper (with the exception of errors in adding up exam points). Do not write on the exam pages or alter the exam in any form. Exams are graded based on a specific set of guidelines and requests to alter these will be denied out of fairness to the class. Legitimate regrade requests will be granted in the case details have been overlooked during the grading process where partial credit has not already been awarded.

**Special notes:** The University of Connecticut provides upon request appropriate academic adjustments for qualified students with disabilities at the Center for Students with Disabilities (CSD). If you have a documented disability for which you wish to request academic accommodations and have not contacted the CSD, please do so as soon as possible. The CSD is located in Wilbur Cross, Room 204 and can be reached at (860) 486-2020 or at csd@uconn.edu. Detailed information regarding the accommodations process is also available on their website at [http://www.csd.uconn.edu](http://www.csd.uconn.edu), 860-486-2020 (voice), 860-486-2077 (TDD). Inform me if you have CSD requirements.

**Observance of university policies:** Standard university policies relating to accommodation for students with disabilities, NCAA student-athletes, and to academic misconduct will be followed in this course. Information regarding academic misconduct policies may be found in the “Student Code” available from the Division of Student Affairs, [http://www.community.uconn.edu/student_code.html](http://www.community.uconn.edu/student_code.html).

**Measurement and evaluation:** Standard course/instructor/TA evaluations will be administered at the end of this course. The student evaluation of teaching (SET) will be completed online.

**Specific goals:**

a. **Course Outcomes:** After completing ME 2234 students should be able to:

1. Understand the components and basic assumptions for the Rankine cycle with and without cycle modifications
2. Understand the components and basic assumptions for the vapor-compression refrigeration system
3. Understand the components and basic assumptions for the Brayton, Otto, and Diesel cycle
4. Compute energy and entropy balances for each component through a cycle to determine unknown items for the cycle as a whole
5. Compute thermodynamic properties for mixtures
6. Compute stoichiometric balances and equivalence ratios
7. Perform an energy balance for a reacting system

b. **Relationship of Course Outcomes to Criterion 3 Student Outcomes:**
a) an ability to apply knowledge of mathematics, science, and engineering: Students acquire the skills to apply the laws of thermodynamics in mathematical form for the solution and optimization of thermal engineering systems.
b) an ability to design and conduct experiments, as well as analyze and interpret data: not applicable
c) an ability to design a system, component, or process to meet desired needs: Students gain design skills through assigned Design Project work.
d) an ability to function on multi-disciplinary teams: Students gain team experience working in their Design Project groups.
e) an ability to identify, formulate, and solve engineering problems: Students learn to identify, formulate, and solve engineering problems using the basic principles of thermodynamics.
f) an understanding of professional and ethical responsibility: not applicable.
g) an ability to communicate effectively: Students gain experience in written communication through the Design Project report.
h) the broad education necessary to understand the impact of engineering solutions in a global and societal context: Students learn about the importance of efficient energy utilization from a perspective of limited energy resources (optimization of system efficiency) as well as the pollution prevention aspect (combustion and air pollution).
i) a recognition of the need for, and an ability to engage in life-long learning: not applicable
j) a knowledge of contemporary issues: Students obtain a knowledge of contemporary issues through the design of internal combustion engines (with consideration of pollution aspects), aircraft engines, and land based gas turbine engines.
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice: Students learn to use analysis techniques and methods to solve problems in thermodynamics (and where applicable the integration of different subjects) in the design and optimization of thermal systems.

Topics covered:

• Vapor power systems: Rankine cycle  
• Vapor power systems: superheat and reheat  
• Refrigeration and heat pump systems  
• Gas power systems  
• Thermodynamic relations for simple compressible substances  
• Non-reacting gas mixtures  
• Psychrometry  
• Reacting gas mixtures and combustion
## Class schedule, Spring 2015 (subject to periodic revision)

<table>
<thead>
<tr>
<th>Date</th>
<th>Week</th>
<th>Topic</th>
<th>Reading</th>
<th>Homework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 21–23</td>
<td>1</td>
<td>• Introduction and Review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan. 26–30</td>
<td>2</td>
<td>• Vapor Power Systems: Rankine Cycle I</td>
<td>• 8.1–8.4</td>
<td>Set 1 Due: W 1/28</td>
</tr>
<tr>
<td>Feb. 2–6</td>
<td>3</td>
<td>• Vapor Power Systems: Rankine Cycle II</td>
<td>• 8.5–8.6</td>
<td>Set 2 Due: W 2/4</td>
</tr>
<tr>
<td>Feb. 9–13</td>
<td>4</td>
<td>• Gas Power Systems II</td>
<td>• 9.1–9.4</td>
<td>Set 3 Due: W 2/11</td>
</tr>
<tr>
<td>Feb. 16–20</td>
<td>5</td>
<td>• Refrigeration and Heat Pump Systems I</td>
<td>• 9.5–9.11</td>
<td>Set 4 Due: W 2/18</td>
</tr>
<tr>
<td>Feb. 23–27</td>
<td>6</td>
<td>• Refrigeration and Heat Pump Systems II</td>
<td>• 10.1–10.4</td>
<td></td>
</tr>
<tr>
<td>Mar. 2–6</td>
<td>7</td>
<td>• Thermodynamic Relations I</td>
<td>• 11.1–11.3</td>
<td>Set 5 Due: W 3/4</td>
</tr>
<tr>
<td>Mar. 9–13</td>
<td>8</td>
<td>• Thermodynamic Relations II</td>
<td>• 11.4–11.7</td>
<td>Set 6 Due: W 3/11</td>
</tr>
<tr>
<td>Mar. 16–20</td>
<td>9</td>
<td>Spring Recess, No Classes</td>
<td></td>
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<tr>
<td>Mar. 23–27</td>
<td>10</td>
<td>• Non-reacting Gas Mixtures I</td>
<td>• 12.1–12.4</td>
<td>Set 7 Due: W 3/25</td>
</tr>
<tr>
<td>Mar. 30–Apr. 3</td>
<td>11</td>
<td>• Non-reacting Gas Mixtures II</td>
<td>• 12.5–12.9</td>
<td>Set 8 Due: W 4/1</td>
</tr>
<tr>
<td>Apr. 6–10</td>
<td>12</td>
<td>• Reacting Gas Mixtures and Combustion I</td>
<td>• 13.1–13.3</td>
<td>Set 9 Due: W 4/15</td>
</tr>
<tr>
<td>Apr. 13–17</td>
<td>13</td>
<td>• Reacting Gas Mixtures and Combustion II</td>
<td>• 13.4–13.7</td>
<td>Set 10 Due: W 4/22</td>
</tr>
<tr>
<td>Apr. 20–24</td>
<td>14</td>
<td>• Chemical Equilibrium I</td>
<td>• 14.1–14.4</td>
<td>Set 11 &amp; Design Project Report</td>
</tr>
<tr>
<td>Apr. 27–May 1</td>
<td>15</td>
<td>• Chemical Equilibrium II</td>
<td>• 14.5–14.6</td>
<td>Due: W 4/29</td>
</tr>
<tr>
<td>May 4</td>
<td>16</td>
<td>• Final Exam, Monday 5/4, 8:00–10:00 a.m. (Chapters 8–14) — Verify schedule with registrar</td>
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*Verify schedule with registrar*