Three Rivers
COMMUNITY COLLEGE

Thermodynamics: Spring 2012
Course # MEC K241
Technologies Department

Course Description:

This course is an introduction to the concept of energy. It provides the basic tools necessary for the analysis of any engineering system in which energy transfer or energy transformations occur; thus, thermodynamics is an important part of the training of almost all engineering disciplines. This course studies the principle of energy transport and work; properties of substances and equation of state; first and second laws of thermodynamics; applications to mechanical cycles and systems. The use of thermodynamics data tables and charts will be stressed.

Instructor:

PROF Patrick H. Knowles Jr. Room C-160 ph: 885-2379 pknowles@trcc.commnet.edu

Text Book:

Introduction to Engineering Thermodynamics – Sonntag, R.E. ISBN 0-471-32172-9

Procedure:

The course will consist of a lecture. The lecture will consist of open discussion, during which the student is encouraged to ask questions and relate their own experiences. The discussions will be conducted around the reading assignments and the comprehension quizzes.

Lecture Outcomes:

- Students will demonstrate the ability to use appropriate mathematical and computational skills needed for engineering technology applications.
- Students will have the ability to work professionally in both thermal and mechanical systems areas including the design and realization of such systems.
- Students will illustrate an ability to think critically and identify, evaluate and solve complex technical and non-technical problems; demonstrate creativity in designing problem solutions; and conduct and interpret experimental data and outcomes.

Lecture Performance Criteria:

The above outcomes will be assessed using these performance criteria:

- Mathematical and computational skills-
  - ✓ Ascertain problem conditions by identifying known and unknown quantities in formulating a problem for solution
  - ✓ Demonstrates the correct selection and application of pertinent formulae, principles and concepts.
  - ✓ Pursue solutions in a methodical, logical manner with results correctly explained with sufficient detail and properly documented
  - ✓ Submit problem solutions with a minimum of computational errors, identifying and selecting the correct dimensional units

- Work in both thermal and mechanical systems areas including design-
    - ✓ Show an understanding of the engineering design process by designing a mechanical system
    - ✓ Be able to design a multi-component thermo-fluid system.
- Illustrate an ability to think critically and identify-
    - ✓ Show the ability to evaluate the credibility of sources of information
    - ✓ Demonstrate the ability to refine generalizations, establish rational & pertinent assumptions, and avoid oversimplifications.
    - ✓ Exhibit the ability to generate, analyze / evaluate, and assess multiple engineering problem solution options
    - ✓ Produce documentation that reflects organization and application of engineering principles in specifying solution to an engineering problem
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Instructor Assistance:

Seeking help from the instructor outside of class is encouraged if you are having difficulty understanding course material. Feel free to Email/call for an appointment during office hours.

Academic Integrity:

Academic integrity is essential to a useful education. Failure to act with academic integrity severely limits a person's ability to success in the classroom and beyond. Furthermore, academic dishonesty erodes the legitimacy of every degree awarded by the College. In this class and in the course of your academic career, present only your own best work; clearly document the sources of the material you use from others; and act at all times with honor.

Attendance:

Attendance will be taken and although it is not intended to be use for grading purposes, it maybe used for decision on the part of the final grade.

Grading Policy:

Several exams will be given during the semester. The dates of the exams are noted in the Lecture Schedule. Approximately one hour of the class meeting will be devoted for each exam. Final grades will be based on a normal distribution of all students taking the course based on the following weighting:

Exam Average	35%
Design Project	30%
Homework	35%

Withdrawal:

A student who finds it necessary to discontinue a course must complete a "Withdrawal Request Form" available in the Registrar's office within the time limits of the semester calendar. <u>Students who do not withdraw, but stop attending will be assigned an "F" signifying a failing grade</u>. The last day to withdraw from classes is 10May2010.

Disabilities Statement:

If you have a question regarding a disability that may affect your progress in this course, please contact one of the college's Disability Service Providers as soon as possible. Chris Scarborough (892-5751) generally works with students who have learning disabilities or attention deficit disorder. Kathleen Gray (885-2328) generally works with students who have physical, visual, hearing, medical, mobility, and psychiatric disabilities. Matt Liscum (383-5240) also works with students who have disabilities.

If you will need accommodations for this class, you must contact the Disabilities Counseling Services. To avoid any delay in the receipt of accommodations, you should contact the counselor as soon as possible. *The instructor cannot provide accommodations until an accommodation letter from the Disabilities Counselor is received.*

Homework Policy:

There will be approximately weekly homework sets due in class on Tuesday. Homework will be graded (select problems) and the instructor may choose to solve some problems in class. Homework will count as specified in the 'Grading Policy' section of this syllabus. Late homework of up to 48 hours (i.e. Thursday @ 1:00pm) will be accepted. Late homework is worth half-credit. Your lowest homework score will be dropped.

Collaboration Policy:

Collaboration on the homework is limited. You MUST first try all the problems yourself. You may consult books and published papers, but not old assignments or those of other students. First try every homework problem BY YOURSELF without discussing it with anyone.

If you get stuck, you can TALK about the homework with your fellow students, but all exchanges of information must be general in nature and either exchanged verbally, or with modern replacements for talking (i.e. texting and emailing is ok too, as long as details are avoided -see below). For example the following Q&A is permissible:

> **Q:** *"I got a density of one atom per cubic parsec. Isn't that awfully low for a molecular cloud?"*
>
> **A:** *"Yup, sure is. Did you remember to convert solar masses into grams, and include Cosmic Ray heating as discussed in chapter X?"*

The following one is NOT permissible:

Q: *"I'm stuck on problem 2. Can you help me?"*

A: *"Sure. You take equation 3.12 of the text, insert equations 2.5 and 3.2, integrate and you should get the right answer which is V k squared over pi squared".*

Visual exchanges of information are strictly forbidden -you may not trade equations, graphs, or computer programs in any form. After any discussion with others, you must write up your own homework by yourself, without reference to anyone else's.

In real research, no one else knows the answer to the problems you work on (otherwise why would you be doing them?), so the most important thing you can learn from homework is how to think and solve for yourself, and be confident in your answers.

Date		Class #	Topic	Reading	Hmwk
1/23	1/25	1	Introduction, Definitions, Units, Systems	1.1-1.3	
			Properties, State, Processes, Cycles	1.4-1.7	
			State postulate, Temperature	1.8-1.9	
			Pressure, Problem-Solving, Energy	1.10-1.13, 2.1	
1/30	2/1	2	Heat Transfer, Work	2.2-2.4	
			The First Law of Thermodynamics	2.5	
			Energy Conversion Efficiencies	2.6	
2/6	2/8	3	Pure Substance, Phase-Change	3.1-3.3	
			Property Diagrams	3.4	
			Thermodynamic Property Tables	3.5	
2/13	2/15	4	The Ideal-Gas Equation of State	3.6	
			Compressibility Factor, Other Equations of State	3.7-3.8	
			Test 1 for Chapters 1-3		
			Moving Boundary Work	4.1	
holiday	2/22	5	Energy Balance for Closed Systems	4.2	
			Specific Heats	4.3	
			Internal Energy, Enthalpy, Specific Heats for Ideal Gases	4.4	
			Internal Energy, Enthalpy, Specific Heats of Solids and Liquids	4.5	
2/27	2/29	6	Mass Balance for Control Volumes	5.1	
			Flow Work and the Energy of a Flowing Fluid	5.2	
			Energy Balance for Steady-Flow Systems	5.3	

3/5	3/7	7	Some Steady-Flow Engineering Devices	5.4	
			Nozzles, Diffusers	5.4	
			Turbines, Compressors	5.4	
			Throttling valves, Mixing chambers	5.4	
3/12	3/14	8	Heat exchangers, Pipe and duct flow	5.4	
			Unsteady-flow process	5.5	
			Introduction to the Second law, Thermal Reservoirs	6.1-6.2	
			Heat engines	6.3	
			Test 2 for Chapters 4 and 5		
3/19	3/21	**Spring Break**			
3/26	3/28	9	Refrigerators, Heat Pumps, Perpetual-Motion Machines	6.4-6.5	
			Reversible & Irreversible Processes, Carnot cycle	6.6-6.7	
			Carnot Principles, The Thermodynamic Temperature Scale	6.8-6.9	
			Carnot Heat Engine	6.10	
			Carnot Refrigerator and Heat Pump	6.11	
			Entropy	7.1	
			The Increase of Entropy Principle	7.2	
4/2	4/4	10	Entropy Change of Pure Substance, Isentropic Processes	7.3-7.4	
			Property Diagrams Involving Entropy, What Is Entropy	7.5-6.6	
			T ds Relations, Entropy Change of Liquids and Solids	7.7-7.8	
4/9	4/11	11	Entropy change of Ideal Gases	7.9	
			Reversible Steady-Flow Work, Compressor work	7.10-7.11	
			Isentropic Efficiencies of Steady-Flow Devices	7.12	

			Entropy Balance	7.13	
4/16	4/18	12	**Test 3 for Chapters 6 and 7**		
			Basic Considerations in the Analysis of Power Cycles	9.1	
			An Overview of Reciprocating Engines	9.4	
			Otto Cycle: The Ideal Cycle for Spark-Ignition Engines	9.5	
4/23	4/25	13	Rankine Cycle: The Ideal Cycle for Vapor Power Cycles	10.2	
			Deviation of Actual Vapor Power Cycles From Idealized Ones	10.3	
			Review		
4/30	5/2		float		
5/7	5/9		float		
5/14			float		