ENGR 3203
Lecture 1
Syllabus & Thermo Concepts

Syllabus http://evan.lemley.org/courses/engr3203_spring_2011/engr3203_syllabus_spring_2011.pdf

Intro

What is thermodynamics?

http://www.google.com/search?hl=en&defl=en&q=define:thermodynamics&ei=-1xDS4PpCIiGNvrN0IgJ&sa=X&oi=glossary_definition&ct=title&ved=0CAcQkAE

Lotso' definitions – we will go with two facts about Thermo to define it:

Science of conversion of energy from one form to another.

Based on experimental observation

Where does thermo fit in scheme of mechanics, physics, etc...?

In physics and engineering - mechanics covers interactions of particles and bodies, forces between them and their energies. Mechanics does not account for heat transfer or thermal energy transfer... thermodynamics combines mechanics with general considerations of thermal transfer to analyze devices, systems, the universe etc...

Is heat transfer the same thing as thermodynamics?

NO! A heat transfer course is about the detailed mechanisms of the three modes of heat transfer (conduction, convection, and radiation)... heat transfer rates are estimated from these detailed mechanisms and governing laws.

In thermo we also calculate heat transfer sometimes, but in different ways than in a heat transfer course: (1) The amount of heat transfer to make energy conservation true, and (2) The amount of heat transfer for an ideal reversible process.

What is hard/confusing/etc about this course?

In this course you will learn to calculate things like work, power input/output, heat transfer, etc... but be careful of the following things that may confound your understanding of what you are doing:

Much of what we will do will be for ideal conditions and/or ideal processes – so our answers are sometimes the *ideal answers.* This does not mean they are not useful since these answers will give the best case (and sometimes worst case) for a given problem. Note there are only two ways to get rid of this idealization: (1) run controlled experiments or (2) run detailed (validated and verified) simulations.

You need to know about significant digits, how to use your calculator, and calculation fundamentals. We also use English Units sometimes (since much work in the US is still done in these units). You may not remember or know much about g_c or degrees *Rankine* or *British Thermal Units*, but you need to. Take the time to review the following:
http://evan.lemley.org/courses/engineering_calculations_spring_2007.pdf

This course will take you a lot of time outside of class. You need to *come to the drill sessions prepared*. We give a quiz every week and a great deal of your grade is based on this quiz. If you diligently prepare for the quiz each week you will be more prepared for the exams.

Looking up properties in the Thermo tables in the appendix of your book may appear to be easy, but based on years of observation: ***At first, it is very hard to figure out the state of a substance and the desired properties. But you can do it by spending time on it (but don't underestimate the time required)***

Assumptions!!! There is a famous saying about this, but the important thing is to learn to make appropriate assumptions. You cannot really start a problems until you have done this.

Don't forget other subjects – you still need statics, calculus, algebra, chemistry. We make use of these subjects here, you should review these things. *We will assume you can do things from these subjects* and will not generally explain how (as you should already know).

What is in the book?
- Student Companion Site (all password protected)
  - http://bcs.wiley.com/he-bcs/Books?action=index&itemId=0470041927&bcsId=4321
- Instructor Companion Site:
  - http://bcs.wiley.com/he-bcs/Books?action=index&itemId=0470041927&bcsId=4358
- Each Chapter contains:
  - Thermo description
  - Problems
  - Example Problems
- Reference Tables in Appendices A & B (necessary for working problems and understanding Thermo)

Things you can understand with Thermo (Sontagg et al, 1.1 – 1.8)
- Energy Production
  - Steam Power Plants (Thermal Plants)
    - What is a steam generator?
      - Generates steam from a compressed liquid by heat transfer (coal, natural gas, nuclear fission, solar)
      - http://upload.wikimedia.org/wikipedia/commons/e/e2/Steam_Generator.png
      - http://upload.wikimedia.org/wikipedia/commons/8/89/Nuclear_steam_generator.jpg
    - What is a turbine-generator?
      - Decreases pressure of steam and turns a shaft – shaft is attached to a generator, which is like a motor in reverse – coils of wires being turned on the shaft in a magnetic field.
      - http://geothermal.marin.org/Geopresentation/images/img038.jpg
    - What is a condenser?
      - Used to condense vapor to liquids – Power/HVAC/Auto/Other Industry
      - http://upload.wikimedia.org/wikipedia/commons/8/8b/Surface_Condenser.png
    - What is a pump?
      - Used to move liquids (by increasing their pressure.
      - Lots of types: We are mostly talking about centrifugal pumps.
      - http://upload.wikimedia.org/wikipedia/commons/3/30/CetriFugal_Pump.jpg
    - Power Plants I have visited/toured/worked at:
      - Coal:
        - Reid Gardner Power Station - Nevada (http://ndep.nv.gov/news/GRAPHIC/reid_gardner0208.jpg)
        - Gallatin Power Station – Tennessee (http://farm3.static.flickr.com/2603/4150439371_1f98aa257f.jpg)
        - Colbert Power Plant – Alabama (http://www.industcards.com/colbert.jpg)
        - Paradise Power Plant – Kentucky (http://farm2.static.flickr.com/1388/1206685188_2ef4745700.jpg)
      - Nuclear:
        - Arkansas Nuclear One – Arkansas (http://www.nrc.gov/images/reading-rm/photo-gallery/20071116-002.jpg)
        - Experimental Breeder #1 – Idaho (http://upload.wikimedia.org/wikipedia/commons/4/43/Ebr-1.zdv.jpg)
        - EBR-1 First produced power in 1951 first reactor in the world to do so - http://www.euronuclear.org/info/encyclopedia/n/nuclear-power-plant-world-wide.htm

Experimental Breeder #2 / Integral Fast Reactor – Idaho
(http://users.owt.com/smsrpm/nksafe/images/80s/ebrfcfex.jpg)
Missouri University of Science and Technology Reactor Facility (http://reactor.mst.edu/)
I actually made the reactor go critical! I have the certificate somewhere!

Fuel Cells (Direct Electricity Production)
What gases can be used?
What happens in the ion exchange membrane?
What is the waste effluent from the type of fuel cell in the book?
Gas Turbines
Nat. gas power plants
What is the waste?

Refrigeration, Air Conditioning, and Heat Pumps
What is an evaporator?
Used to evaporate (vaporize) liquids. Very common in HVAC/Industry/etc...
http://www.residential.carrier.com/images/products/coil-evap-pupa-lg.jpg

What is a compressor?
Used to compress vapors. Very common in HVAC/Industry/autos/etc
http://upload.wikimedia.org/wikipedia/commons/3/31/Two_moving_spirals_scroll_pump.gif

What is a condenser?
Used to condense vapor to liquids – Power/HVAC/Auto/Other Industry
http://upload.wikimedia.org/wikipedia/commons/8/8b/Surface_Condenser.png

What is an expansion valve?
Used to meter refrigerants in HVAC systems – big pressure drop!
http://www.hvacmechanic.com/txv.htm

Thermoelectric Refrigeration (Direct Refrigeration)
EMF generated between two dissimilar metals when heated, by applying external EMF will heat and cool dissimilar metals. (thermocouples)
Chemical Separation
Propulsion
Environmental Effects