Learning Objectives for Thermodynamics Portion of ES 202

- Find properties T, P, v, u, h, s, x
    - Water and refrigerant 134-a in liquid and vapor phases ("pure substances")
    - Air with variable Cp
- Describe a compressed liquid (CL), saturated liquid (SL), saturated mixture (SM), saturated vapor (SV), and superheated vapor (SHV)
- Determine whether a gas at known pressure and temperature behaves like an ideal gas
- Sketch and label T-v, p-v, & T-s diagrams:
    - CL, SL, SM, SV, SHV regions, critical point, vapor dome
    - p=const line, T=const line, v=const line, s=const line
- Solve 1st and 2nd law problems for open and closed systems similar to Con Apps but using
    - water & refrigerant involving phase change
    - air with variable Cp (compare to constant Cp assumption)
- State the purposes and common assumptions for 7 steady-state flow devices
    - nozzle, diffuser, compressor, turbine, valve, mixer, heat exchanger
- Sketch T-s diagrams and identify the inlet and exit states for 7 steady-state flow devices
- Define the isentropic efficiencies for a turbine, compressor, and nozzle
- Solve 1st and 2nd law problems for multiple flow devices linked together (i.e., a cycle)
    - Brayton, Rankine, V-CR actual and ideal

Lab exercises that support these objectives:

Thermodynamic Properties Lab – Week 2
Cycles Lab – Week 4

Learning Objectives for Fluid Mechanics Portion of ES 202

- State the definition of a fluid and the relationship between shear stress and viscosity in a fluid
- Find the viscosity of air, water, and oil
- Identify a flow with a velocity gradient
- Calculate, for a stationary fluid:
    - hydrostatic pressure at any point in a fluid
    - hydrostatic force and center of pressure on a submerged flat object
    - buoyant force on a submerged or partially submerged object
- Distinguish between mechanical energy and thermal energy
- State the equation and assumptions for the mechanical energy balance (MEB)
- Define and find Reynolds number and friction factor for internal fluid flows w/losses
- Apply the MEB to find ΔP, velocity, elevation, power input, and power output for internal flows with and without losses
- Sketch a velocity boundary layer on a flat plate and in a circular pipe
- Define and calculate Reynolds number, friction factor, lift coefficient, and drag coefficient
    - Flat plate
    - Circular cylinder in cross flow for internal fluid flows
- Calculate the drag force of an object using the momentum deficit method
- Apply the Navier-Stokes equations to Poiseuille Flow and Couette flow to find fluid velocity and shear stress at any point in the fluid

Lab exercises that support these objectives:

Dimensional analysis lab – Week 5
Wind Tunnel Lab: Momentum Deficit and Pitot-static tubes – Week 6
Fluid Friction Lab: Pipe flow and flow meters – Weeks 7 & 8