Exam 3 Review Sheet

Chapters 7-10 in 4th Edition (7-9, 11 in 3rd Edition)

<u>Ch. 7 Energy Balances</u>

1. Forms of Energy
   a. Internal, Potential, and Kinetic energy
   b. Heat and Work (Sign convention for both of these)
2. Closed system energy balance
   a. Significance of "Δ" (final minus initial)
   b. Simplification of energy balance for closed systems
   c. Work term for closed systems (PV work)
3. Open system energy balance
   a. Significance of "Δ" (out minus in)
   b. Definition and use of enthalpy
   c. Shaft work
   d. Application to problems
4. Steam tables
   a. Saturated conditions (Tables B.3, B.5, B.6, first column in B.7)
   b. Non-saturated conditions (Table B.7)
5. Mechanical Energy Balance
   a. Bernoulli's equation

<u>Ch. 8 Energy Balances (Non-Reactive Systems)</u>

1. Enthalpy is a state function (path independent)
2. $\dot{Q} = \sum_{out} \dot{n}_i \hat{H}_i - \sum_{in} \dot{n}_i \hat{H}_i$
3. Inlet-Outlet Enthalpy Table
4. Heat Capacities (Table B.2)
5. Phase Change (Heat of melting, vaporization) (All columns in Table B.1)
6. Special cases (adiabatic, isobaric, isochoric, isentropic)
7. P-H diagrams (steam, refrigerants), cycles
8. Psychrometric chart (Air-water at 1 atm)
   a. Definitions (wet bulb temperature, humid volume, absolute vs. relative humidity, dew point, etc.)
   b. Application to problems (use of dry air balance)
9. Skipped -- Heats of Mixing

<u>Ch. 9 Energy Balances (Reactive Systems)</u>

1. Heat of Reaction, Heat of Formation, Heat of Combustion
2. Energy Balances
   a. Path Method: Use ΔH_r method (follow path from reactants to 25°C, then ΔH_r at 25°C, then products up to final temperature)
   b. In&Out Table: Use $\Delta\hat{H}_i = \Delta\hat{H}_{f,i}^0 + \int_{25°C}^{T} C_{p,i} dT$ and construct table of inlet and outlet enthalpies (but ΔH_r not formally used)
3. Applications
   a. Combustion
   b. Adiabatic flame temperature
4.

<u>Ch. 10 Transient Material Balances</u>

1. General balance equation
2. Applications to both overall mass/moles and/or species (we will not cover energy here)

Competency Expectations

- Students will be able to calculate the work of pumps, turbines, and/or compressors.
- Students will be able to set up and solve steady state energy balances (1st law of thermodynamics) for closed and open systems.
- Students will be able to set up and solve transient mass balances.
- Students will understand and be able to apply the concepts of heat capacity, latent heat, heat of reaction, heat of combustion, and heat of formation.
- Students will be able to calculate internal energy & enthalpy at system conditions assuming ideal behavior.

Things to write on your 8.5 x11 sheet (both sides):

- Energy balance for open and closed systems
- How to get U from H or ΔU from ΔH
- General balance (accumulation = in – out …)
- Mechanical Energy equation and Bernoulli's equation
- Definition of heat capacity
- Calculation of specific enthalpy from heat of formation and enthalpy
- Calculation of C_v from C_p
- $\dot{m} = \rho A v = \rho \dot{V}$
- Path method for energy balance (using ΔH_{rxn})
- Out-In table method for energy balance
- High vs. low heating value
- Transient material balance equations