Tentative Outline of Material

I. Thermodynamic principles [E&R pp.1-13]
   A. Nature of thermodynamic arguments
   B. State variables and equations of state
      Pressure, Volume, Temperature
      1. Temperature- Ideal gas thermometer [E&R pp. 5-6; handout]
      2. Ideal gas law :
         relationship to mechanics and molecular structure [E&R pp 2-4]
   3. non-ideal gases:
      van der Waals equation of state [E&R sec 1.5, also E&R sec 7.1-7.2]

II. Mathematics applied to thermodynamics [E&R 45-49]
[E&R Appendix B.2, B.6; handout]

III. The first law of thermodynamics [E&R pp. 17-77]
   A. Heat and work
   B. Internal energy as a state function
   C. Enthalpy
   D. Maxwell-Euler relationships from dU and dH
   E. Heat capacities
   F. Applications to real and ideal gasses
   G. Thermochemistry [E&R 67-77]

MIDTERM #1 ON FRIDAY JANUARY 31ST

IV. The second law of thermodynamics [E&R pp.85-119]
   A. Physical statements of second law [E&R p. 89; handout]
   B. Heat engines and efficiency [handout; E&R sec 5.2]
   C. Disorder and the statistical nature of entropy [handout; E&R p. 383]
   D. Mathematical definition of entropy and second law [E&R sec 5.3]
   E. Implications of the second law of thermodynamics [E&R sec 5.5]
   F. Calculations of entropy changes [E&R sec 5.4]
   G. Third law and absolute entropy [E&R sec 5.8]

V. Free energy, spontaneity, and equilibrium [E&R pp. 125-160]
   A. Helmholtz and Gibbs free energy and spontaneity [E&R sec. 6.1]
   B. Maxwell-Euler relationships from dA and dG [E&R sec. 6.2-6.3]
   C. Equilibrium conditions [E&R sec. 6.4-6.8]
   D. General relationships among thermodynamic variables
   E. Temperature and pressure dependence of free energy [E&R sec. 6.10-6.13]

MIDTERM #2 ON WEDNESDAY FEBRUARY 26TH

VI. Open and multicomponent systems
   A. Dependence of state functions on n_i
   B. Chemical potential μ_i and equilibrium [E&R sec 6.4]
   C. Phase changes and phase equilibrium [E&R 181-197]

VII. Applications
- A. Non-ideal gasses; fugacity and activity [E&R sec 7.5]
- B. Solutions of nonelectrolytes [parts of E&R pp.209-239]
  1. Ideal solutions
     a. Vapor pressure
     b. Colligative properties
  2. Non ideal solutions
- C. Solutions of electrolytes
  1. General considerations and ionic activities [E&R sec 10.3]
  2. Debye-Huckel theory of activity coefficients [summary of E&R sec 10.2 and 10.4]
- D. Electrochemistry [summary of E&R sec 11.1-11.8]

FINAL EXAM ON MARCH 20TH , THURSDAY, 12:00-3:00 PM