Review for ME323 final exam, spring 06:

Closed book and notes—I will provide sheet of equations and other necessary information. Calculators ok.

The exam is like a test of concepts more than crunching numbers. There will be some calculations that emphasize knowing what terms go into which expression.

1. Forced convection
   - meaning of Nu, Pr, Re
   - exact solutions for Nu (laminar flow, \( T_s = \text{const.}, q_s = \text{const.} \))
   - when correlations needed (turbulent, complex geometry)

   Internal flow
   - general knowledge of momentum and thermal boundary layers, entrance lengths and fully developed states, boundary layer transition point (i.e. \( \text{Re}_{D,c} \approx 2300 \))
   - use of hydraulic diameter
   - use of \( T_f \), film temperature to evaluate fluid properties

   External flow
   - momentum and thermal boundary layers and thicknesses, turbulent transition points (i.e. \( \text{Re}_{x,c} \approx 50,000 \))
   - \( \text{Re}_L, \text{Nu}_L, \text{Cf}_L \) and the general idea of surface averaged quantities
   - use of \( T_m \), average of the mean temperature to evaluate fluid properties

2. Natural convection
   - meaning of Gr, Ra, \( \beta \), Pr
   - general understanding of mechanism, velocity and temperature profiles
   - general solution procedure: guess temperature(s) if not provided, compute \( h_{\text{nat conv.}} \) and go improving temperature difference if needed
   - ‘feel’ of natural convection in enclosures

3. Heat exchanger design
   - heat exchanger types
   - overall heat transfer coefficient
   - general knowledge of log mean temperature difference and NTU methods

4. Radiation
   - radiation spectral intensity
   - emissive power of radiation, irradiation, and radiosity
   - shape factors
   - blackbody, graybody, surface properties
   - impact of emissivity, absorptivity, reflectivity, transmissivity
   - resistor analogy

5. General approach to mixed H.T.: conduction, convection, radiation