ME 18b, HW 6

Due Thursday May 21, 2009 (accepted until 4 pm)

Note: This homework is due on a Thursday not a Tuesday

TAs for HW #6:
Xiaobai and Julianne

Number of classes attended: _____

Hours spent on homework: _____

1. Ideal Gas Mixtures A mixture of 60% nitrogen and 40% oxygen on a molar basis is contained in a frictionless piston-cylinder assembly at 200 kPa and 175°C. The cylinder has an initial volume of 0.8 m^3. The mixture is compressed adiabatically until the pressure reaches 450 kPa. Determine the final temperature of the mixture and the work for this process. Compare these values to air using either the cold air standard assumptions or variable specific heat method for the process.

2. Air Conditioning Process A combination cooling and reheat process is used to deliver air at a dry bulb temperature of 20°C and a relative humidity of 40%. The air enters at a dry bulb temperature of 29°C with a relative humidity of 70% and a volumetric flow rate of 45 m^3/min. Determine the heat transfer rate in the cooling section and the heating section and the mass flow rate of the condensate from the cooling section.

3. Air Conditioning Process A 1000-m thick cloud (assume the ambient pressure is 100 kPa, and ignoring the effects of altitude) contains air at 27°C and 90% relative humidity. Suppose the cloud rises up and its temperature decreases by 20°C. Estimate the depth of rainfall produced by the cloud.

4. Air Conditioning Process A power plant utilizes a steady-flow natural-draft, wet-cooling tower at 1 atmosphere. The air temperature entering the tower is 20°C and 50% RH and the air leaving the cooling tower is 32°C and 80% RH. Makeup water is available from a source that's at 15°C. Water from the condenser enters the cooling tower at 70°C at a flow rate of 100 kg/s and is cooled to 40°C. Calculate the following:

a. The heat transfer rate from the condenser water

b. The mass flow rate of makeup water required

c. The volume flow rate of moist air entering the cooling tower

d. The volume flow rate of moist air that leaves the cooling tower

e. The humidity ratio of the air leaving the cooling tower

f. The dew point temperature of the air leaving the cooling tower.