ME/CH EN 2300 Thermodynamics I
Homework #13
Due Friday April 27th

1. (7-88) An insulated piston cylinder device initially contains 300 L of air at 120 kPa and 17 C. Air is now heated for 15 minutes by a 200-W resistance heater placed inside the cylinder. The pressure of the air is maintained constant during the process. Determine the entropy of the air assuming (a) constant specific heats and (b) variable specific heats.

2. (7-92) An insulated rigid tank is divided into two equal parts by a partition. Initially, one part contains 5 kmol of an ideal gas at 250 kPa and 40 C, and the other side is evacuated. The partition is now removed and the gas fills the entire tank. Determine the total entropy change during this process.

3. (7-95) An insulated rigid tank contains 4 kg of argon gas at 450 kPa and 30 C. A valve is now opened and argon is allowed to escape until the pressure in the tank drops to 200 kPa. Assuming the argon remaining inside the tank has undergone a reversible, adiabatic process, determine the final mass in the tank.

4. (7-99) Nitrogen at 120 kPa and 30 C is compressed to 600 kPa in an adiabatic compressor. Calculate the minimum work needed for this process, in kJ/kg.

5. (7-108) In large compressors, the gas is frequently cooled while being compressed to reduce the power consumed by the compressor. Explain how cooling the gas during a compression process reduces the power consumption.

6. (7-109) The turbines in steam power plants operate essentially under adiabatic conditions. A plant engineer suggests to end this practice. The engineering proposes to run cooling water through the outer surface of the casing to cool the steam as it flows through the turbine. This way, the engineering reasons, the entropy of the steam will decrease, the performance of the turbine will improve, and as a result the work output of the turbine will increase. How would you evaluate this proposal?

7. (7-118) Liquid water at 120 kPa enters a 7-kW pump where its pressure is raised to 5 MPa. If the elevation difference between the exit and the inlet levels is 10 m, determine the highest mass flow rate of liquid water this pump can handle. Neglect the kinetic energy change of the water, and take the specific volume of water to be $0.001 m^3/kg$.

8. (7-128) Steam at 3 MPa and 400 C is expanded to 30 kPa in an adiabatic turbine with an isentropic efficency of 92 percent. Determine the power produced by this turbine in KW when the mass flow rate is 2 kg/sec.