ME/CH EN 2300
Homework #9 Due March 14, 2007

#1 (5-60) An adiabatic gas turbine expands air at 1000 kPa and 500 C to 100 kPa and 150 C. Air enters the turbine through a $0.2m^2$ opening with an average velocity of 40 m/sec, and exhausts through a $1.0 \ m^2$ opening. Determine (a) the mass flow rate of air through the turbine, and (b) the power produced by the turbine.

#2 (5-78) A hot water stream at 80 C enters a mixing chamber with a mass flow rate of 0.5 kg/sec where it is mixed with a stream of clod water at 20 C. If it is desired that the mixture leave the chamber at 42 C, determine the mass flow rate of the cold-water stream. Assume all streams are at a pressure of 250 kPa.

#3 (5-122) Consider and 8-liter evacuated rigid bottle that is surrounded by the atmosphere at 100 kPa and 17 C. A valve at the neck of the bottle is now opened and the atmospheric air is allowed to flow into the bottle. The air trapped in the bottle eventually reaches thermal equilibrium with the atmosphere as a result of heat transfer through the wall of the bottle. The valve remains open during the process so that the trapped air also reaches mechanical equilibrium with the atmosphere. Determine the heat transfer through the wall of the bottle during this filling process.

#4 (5-157) The air flow in a compressed air line is divided into two equal streams by a T-fitting in the line. The compressed air enters this 2.5 cm diameter fitting at 1.6 MPa and 40 C with a velocity of 50 m/sec. Each outlet has the same diameter as the inlet, and the air at these outlets has a pressure of 1.4 MPa and a temperature of 36 C. Determine the velocity of the air at the outlets and the rate of change of flow energy (flow power) across the T-fitting.

#5 (6-9) Is it possible for a heat engine to operate without rejecting any waste heat to a low temperature reservoir? Explain.

#6 (6-15) In the absence of any friction and other irreversibilities, can a heat engine have an efficiency of 100 percent? Explain.