These problems are due on Tuesday July 28.

1. Consider the jet engine from Homework 5-1 but now include an isentropic efficiency of 85% for the compressor and 90% for the turbine. Report the same information as in problem 5-1. Assume variable specific heats.

2. An air standard Brayton cycle has a compressor ratio of 10 and air enters the compressor at 14.7 psia and 70 °F at a mass flow rate of 90,000 lbm/hr. The turbine inlet temperature is 2200R. The compressor and turbine have isentropic efficiencies of 88% and 84%, and a regenerator with an effectiveness of 80% is incorporated in the cycle.
   a) What is the thermal efficiency of the cycle?
   b) What is the net developed horsepower?

3. The vapor compression cycle in the figure has two evaporators and uses R134a as the refrigerant. This arrangement provides cooling at two different temperatures with a single compressor and single condenser. The low temperature evaporator operates at T = –18°C with saturated vapor exiting and providing 3 tons of cooling. The higher temperature evaporator produces saturated vapor at 320 kPa at its exit and has a refrigeration capacity of 2 tons. The compressor is isentropic and the condenser pressure is 1000 kPa. The R134a leaves the condenser as saturated liquid. Determine:
   a) the mass flow in each evaporator, kg/min
   b) the compressor power, kW
   c) the rate of heat transfer from the R134a passing through the condenser.

4. Two kg of a mixture having a mass basis composition of 30% N₂, 40% CO₂, and 30% O₂ is compressed adiabatically in a piston-cylinder arrangement from 100 kPa, 300K to 400 kPa and 500 K. Determine:
   a) the work, in kJ
   b) the entropy production, in kJ/K

5. A gas turbine receives a mixture having the following molar analysis: 10% CO₂, 19% H₂O, 71% N₂ at 720K and 350 kPa and a volumetric flow rate of 3.2 m³/s. Products exit the turbine at 380K and 110kPa with negligible velocity. Determine the power produced under steady flow conditions.