Textbook Reading: 3.9-3.15

HW – 11(i)

Carbon dioxide is heated from -40°C (State 1) to -20°C (State 2) in a constant pressure process at 20 bar in a high-pressure cooling system.
(a) Calculate the change in specific internal energy, in kJ/kg: using compressed liquid tables, using saturated liquid approximation, and using a constant specific heat of 2.082 kJ/kg-K.
(b) Calculate the change in specific enthalpy, in kJ/kg: using compressed liquid tables, using saturated liquid approximation, and using a constant specific heat of 2.082 kJ/kg-K.

HW – 11(ii)

Consider three liquids in separate sections of an externally well-insulated, closed rigid tank. Section A contains 5 kg of liquid A at 100°C with a specific heat of 2 kJ/kg-K. Section B contains 2 kg of liquid B at 50°C with a specific heat of 4 kJ/kg-K. Section C contains 1 kg of liquid C at 40°C with a specific heat of 7 kJ/kg-K. There is heat transfer but no mass transfer across the sections until thermal equilibrium is achieved.

Calculate the temperature at equilibrium, in °C.

HW – 12(i)

A closed, rigid tank is divided into two sections by a partition. One section initially contains air at an absolute pressure of 5 bar, an absolute temperature of 500 K, and a volume of 0.2 m^3 while the other section is perfectly evacuated (State 1). The partition is removed and air expands to fill the entire tank at an absolute pressure of 1.25 bar and a volume of 0.4 m^3 (State 2). Assume constant specific heat c_p = 1.017 kJ/kg-K for air.
(a) Determine the temperature of air at State 2, in K.
(b) Calculate the heat transfer during the process, in kJ.

HW – 12(ii)

A closed, insulated piston-cylinder device contains air at an absolute pressure of 1.5 bar, an absolute temperature of 400 K, and a volume of 0.02 m^3 (State 1). A stirrer in the cylinder adds energy to the air at constant pressure to an absolute temperature of 950 K (State 2). Use air tables that consider variable specific heats.

Calculate the stirrer work, in kJ.

HW – 13

Air (m = 2 kg) contained inside a closed piston-cylinder device undergoes four processes. Use air tables that consider variable specific heats.

Process 1 to 2: A constant temperature process at 600 K from an absolute pressure of 5 bar (State 1) to an absolute pressure of 4 bar (State 2)
Process 2 to 3: A polytropic process $Pv^{1.4}$ = constant to an absolute pressure of 3 bar (State 3)
Process 3 to 4: A constant pressure process
Process 4 to 1: A constant volume process

(a) Calculate the temperature at State 3 and State 4, in K.
(b) Find the work for each process, in kJ.
(c) Calculate the heat transfer for each process, in kJ.
(d) Show the four processes on P-V diagram and the appropriate lines of constant temperature for the four states. Label states and identify process directions with arrows.