CANKAYA UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE
MECHANICAL ENGINEERING DEPARTMENT
ME 212 THERMODYNAMICS II

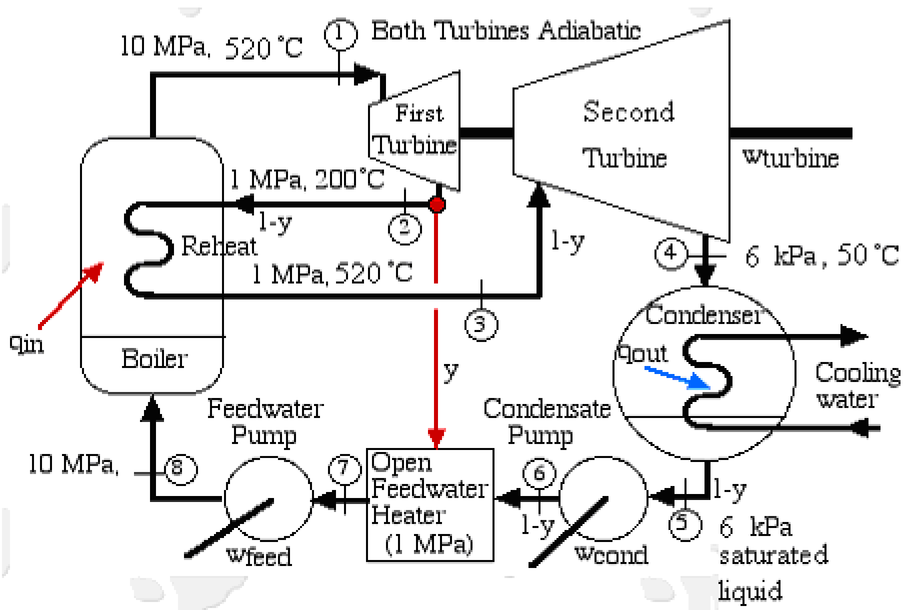
CHAPTER 8
EXAMPLES

1) Consider a steam power plant that operates on a simple ideal Rankine cycle. Steam enters the turbine at 7 MPa and 450 ^{o}C and is condensed in the condenser at a pressure of 10 kPa by running cooling water from a lake through the tubes of the condenser at a rate of 1600 kg/s. Rankine cycle has a net power output of 40 MW. Show the cycle on T-s diagram with respect to saturation lines, and determine (a) the thermal efficiency of this cycle, (b) the back work ratio, (c) the mass flow rate of the steam, in kg/s, and (d) the temperature rise of the cooling water, in ^{o}C.

2)A steam power plant uses water as the working fluid. Steam enters the turbine at 7 MPa and 450 ^{o}C and is condensed in the condenser at a pressure of 10 kPa by running cooling water from a lake through the tubes of the condenser at a rate of 1600 kg/s. Cycle has a net power output of 40 MW. Isentropic efficiency of the turbine is 85 percent, and the isentropic efficiency of the pump is 90 percent. Assuming no pressure losses in the condenser and boiler, show the cycle on T-s diagram with respect to saturation lines, and determine (a) the thermal efficiency of this cycle, (b) the back work ratio, (c) the mass flow rate of the steam, in kg/s, and (d) the temperature rise of the cooling water, in ^{o}C.

3)In a Rankine cycle, saturated liquid water at 10 kPa is compressed in a pump isentropically to 8 MPa. It is then heated, first in a boiler and then by superheating at a constant pressure of 8 MPa, to a temperature of 600 ^{o}C. After an adiabatic reversible expansion to 3 MPa, the steam is reheated to 600 ^{o}C, and a second adiabatic reversible expansion to 10 kPa occurs. This is essentially a reheat cycle (a) What is the total work (kJ/kg) generated. (b) What is the efficiency of the cycle (%)? (c) Sketch the cycle on a T-s diagram.

4) Consider the steam power plant with an open feedwater heater operating under the conditions shown in the following diagram. Saturated liquid exits the open feedwater heater at 1 MPa, and saturated liquid exits the condenser. Each pump operates isentropically. Net power output of the cycle is 100 MW.



Using the conditions shown on the diagram above and values obtained from the steam tables, determine

a. the enthalpy values at all eight stations,

b. the mass fraction, *y*, of steam bled from the turbine set at station (2),

c. the thermal efficiency, η, of this power plant, and

d. the mass flow rate of steam entering the first turbine stage, in kg/h.

e. Show the cycle on *T-s* diagram with respect to saturation lines.

5) Water is the working fluid in a Rankine cycle. Superheated vapor enters the turbine at 10 MPa, 480 ^{0}C, and the condenser pressure is 6 kPa. The turbine and pump have isentropic efficiencies of 80 and 70%, respectively. Determine the rate of exergy input, in kJ per kg of steam flowing, to the working fluid passing through the steam generator. Perform calculations to account for all outputs, losses, and destructions of this exergy. Let $T_0 = 15\,^{0}C$ and $p_0 = 0.1 MPa$ *T*0 5 158C, *p*0 5 0.1 MPa