1999 機械系博士班資格考熱力試題
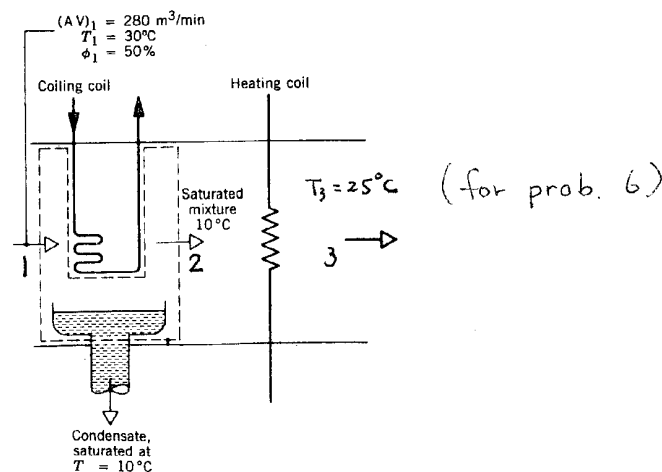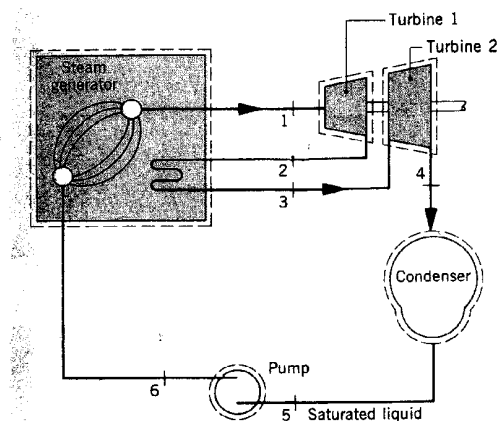
1. (20%) 名詞解釋：
   (a) thermodynamic equilibrium
   (b) quasi-equilibrium process

2. (20%) 詳述以下二定律：
   (a) the first law of thermodynamics
   (b) the second law of thermodynamics

3. (20%) 略述以下各循環並比較之間之異同
   (a) air-standard Otto cycle
   (b) air-standard Diesel cycle
   (c) air-standard Brayton cycle

4. (20%) Two rigid, insulated tanks are interconnected by a valve. Initially n_1 mole of nitrogen at pressure P_1 and temperature T_1 fills one tank. The other tank contains n_2 mole of oxygen at P_2 and T_2. The valve is opened and the gases are allowed to mix until a final equilibrium state is attained. During this process, there are no heat or work interactions between the tank contents and the surroundings. Determine (a) the final temperature of the mixture, (b) the final pressure of the mixture, (c) the amount of entropy produced in the mixing process.

5. (10%) Steam is the working fluid in an ideal Rankine cycle with superheat and reheat (refer to Figure 1). Plot the corresponding T – s diagram for the cycle (mark state 1 to 6 on the diagram).

6. (10%) Moist air $30°C$ and 50% relative humidity enters a dehumidifier operating at steady state with a volumetric flow rate of 280 m^3/min. The moist air passes over a cooling coil and water vapor condenses. Condensate exits the dehumidifier saturated at $10°C$. Saturated moist air exits in a separate stream at the same temperature. There is no significant loss of energy by heat transfer to the surroundings and pressure remains constant at 1.013 bar. Mark state 1, 2, and 3 on the attached psychrometric chart (Figure 2).
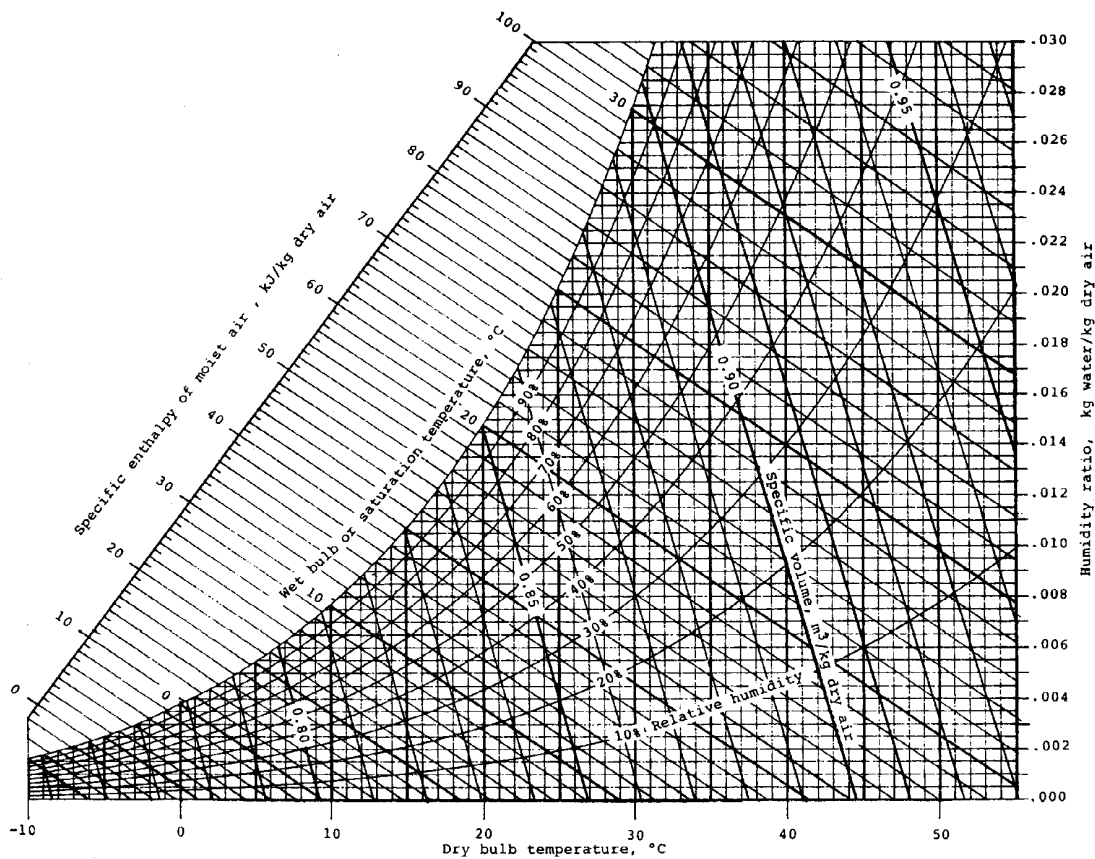
Figure 1   (prob. 5)

Figure 2   (prob. 6)