國立清華大學命題紙

99學年度 工程與系統科學系乙組 碩士班入學考試 *請在【答案卷卡】作答

科目 熱力學 科目代碼 2702 共 3 頁，第 1 頁

1. (a) Give at least three reasons which causes the Irreversible processes (3%)
   (b) At reversible process, write the entropy change dS in terms of (δQ , T) (2%)
   (c) If kinetic energy and potential energy can be neglected in a typical process, which thermal property would be keep at constant for the throtting process (2%)
   (d) Write down the Clausis Statement (2%) and Keylvin-Planck Statement (2%)
   (e) Write down the equation of the Clausis inequality (2%)
   (f) Write down the Thermal Efficiency of the Carnot engine, η_{th}, in terms of (Q_c, Q_H,) (1%) and (T_C, T_H) (1%)

2. Please draw the schematic diagram and the T-S diagram for the following cases, the schematic diagram should include at least 4 components such as turbine, boiler, condenser and pump

   (a) The Rankine cycle (the ideal cycle for a simple power plant) (4%)

   (b) The Rankine cycle for a reheat cycle (4%)
   (c) The Rankine cycle for the practical regenerative (7%)

3. A power cycle operating between two reservoir receive energy Q_H by heat transfer from a hot reservoir at T_H=2000K and rejects energy Q_C by heat transfer to a cold reservoir at T_C=400K. For each of the following cases determine whether the cycle operates reversible, irreversible, or is impossible:

   (a) Q_H=1000KJ, Q_C=200KJ (2%)

   (b) Q_H=1100KJ, W_{cycle}=900KJ (2%)
   (c) W_{cycle}=1400KJ, Q_C=600KJ (2%)
   (d) η_{th}=85% (2%)
   (e) η_{th}=50% (2%)

4. For a Van der Walls gas $(P + \frac{a}{V^2})(V - b) = RT$ at constant temperature, try to evaluate the value of the internal energy change due to volume change from state 1 to state 2. (10%) You may write the answer ΔU as the function of the (V_1, V_2, R, a, b)

5. A steam power plant operates on a cycle with pressure and temperatures as designed in following figure. The efficiency of the turbine is 86% and the efficiency of the pump is 80%. Determine

   (a) The isentropic pump work W_{PS} (2%), The actual pump work W_a (2%)

   (b) The enthaply of state 2 (2%)

   (c) The temperature of state 2, T_{2S} , if the pump working as the reversible and adiabatic (isentropically) process (2%)

   (d) The actual temperature of state 2, T_2 (2%)

   (e) The entropy of state 2, S_2 (2%)

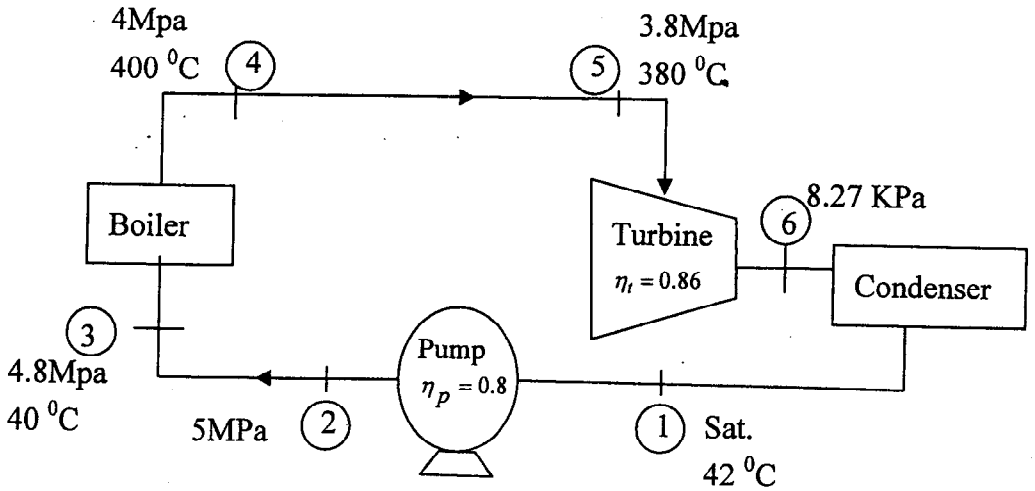
   (f) The quality of state 6, X_{6S} (2%) and The enthalpy of state 6, h_{6S} (2%), if the turbine working as the reversible and adiabatic (isentropically) process

   (g) The actual turbine work W_t (2%), The actual enthalpy of state 6, h_6 (2%)

   (h) The actual quality of state 6, X_6 (2%) , The actual entropy of state 6, S_6 (2%)

   (i) The net work of cycle W_{net} (2%), The heat input of the boiler q_H (2%)

   (j) The thermal efficiency of the cycle η_{th} (2%)



State (Unit)	T (°C)	P (Mpa)	V_f (m^3/Kg)	V_g (m^3/Kg)	U_f (KJ/Kg)	U_g (KJ/Kg)	h_f (KJ/Kg)	h_g (KJ/Kg)	S_f (KJ/Kg,°K)	S_g (KJ/Kg,°K)
Superheat	380	3.8		0.0741		2877.3		3158		6.7159
Superheat	400	4.0		0.07341		2919.6		3213.6		6.769
Saturated	40	7.38×10^{-3}	0.00108	19.52	167.56	2430.1	167.57	2574.3	0.5725	8.257
Saturated	42	8.27×10^{-3}	0.001	17.4	178	2433	178.01	2578.7	0.6057	8.2109
Saturated	46	10×10^{-3}	0.001	14.67	191.82	2437.9	191.83	2584.7	0.6493	8.1502
Saturated	262	4.8	0.00128	0.04	1138.2	2597.86	1146.5	2795.3	2.9	5.987
Subcooled	40	5	0.001		166.95		171.97		0.5705	
Subcooled	60	5	0.00101		250.23		255.3		0.8285	

6. Explain

(a). What is the closed system (2%)

(b). What is the isolated system (2%)

(c). What is the isothermal process (2%)

(d). What is isochoric process (2%)

(e). What is the adiabatic process (2%)

(f). What is intensive properties and give two examples (3%)

(g). What is extensive properties and give two examples (3%)

(h). In one examine, students are asking to stay in the seat and can't move free (can't move away from seat), if he want to pass the information (answer) to the next student, point at least two methods from microscopic view of the molecular energy transfer (4%)