國立雲林科技大學 109 學年度 碩士班招生考試試題

系所：化材系

科目：化工熱力學

1. An ideal gas, initially at 300 K and 2.5 bar, undergoes reversible and cyclic processes in a closed system. It is first compressed adiabatically to 8.2 bar, then cooled at a constant pressure to 300 K, and finally expanded isothermally to 2.5 bar. Let $C_P = 3.5R$ and $C_V = 2.5R$. Calculate W, Q, ΔU, and ΔH for each step of the cyclic processes. (20%)

2. 14.0 mol s^{-1} of nitrogen, $C_P = 3.5R$, is compressed in a steady-flow compressor. Temperatures and velocities are: $T_1 = 320$ K, $T_2 = 480$ K, $u_1 = 12.4$ m s^{-1}, and $u_2 = 2.6$ m s^{-1}. Delivered mechanical power is 110.2 kW. Calculate the rate of heat transfer from the compressor. (14%)

3. An ideal gas, $C_P = 3.5R$, is heated in a steady-flow heat exchanger from 325 K to 385 K by another stream of the same ideal gas which enters at 500 K. The flow rates of the two streams are the same, and heat losses from the exchanger are negligible. (a) Calculate the molar entropy changes of the two streams for parallel flow in the exchanger; (b) What is ΔS_{total}? (16%)

4. Residual mixing entropy S and residual mixing Gibbs energy G are both function of compressibility-factor Z, please show their relationship of Z and how to obtain them. (18%)

5. The enthalpy of a binary liquid system of species 1 and 2 at fixed T and P is represented by the equation: $H=200X_1+300X_2+X_1X_2(20X_1+10X_2)$

   Where H is in J/mol. Determine expressions for $\overline{H}_1$ and $\overline{H}_2$ as function of X_2, numerical values for the pure-species enthalpies H_1 and H_2, and numerical values for the partial enthalpies at infinite dilution $\overline{H}_1^{\infty}$ and $\overline{H}_2^{\infty}$. (12%)

6. (a) Please explain what physical meanings of fugacity, fugacity coefficient, activity, and activity coefficient are, respectively? Please write their difference between pure i specifies and species i in solution. (b) Please show how to gain the modified Raoult's Law. (20%)