

III B.Tech I Semester Supplementary Examinations, April/May 2005
CHEMICAL ENGINEERING THERMODYNAMICS-II
(Chemical Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE Questions
All Questions carry equal marks

1. At steady state, a refrigeration cycle removes 150 kJ/min. of energy by heat transfer from a space maintained at -50°C and discharges energy by heat transfer to surroundings at 15°C . If the COP of the cycle is 30 % of that of a reversible refrigeration cycle operating between thermal reservoirs at these two temperatures, determine the power input to the cycle, in kW.
2. (a) Why sub-cooling is done after isothermal heat rejection at high temperature in a refrigeration cycle.
(b) All reversible heat pump cycles operating between the same two reservoirs have the same COP. Why?
3. Define the terms : activity and activity coefficients. Show that the activity of the constituent 'i' of the given solution is proportional to its fugacity in that solution. Give a brief Discussion of variation of activity in liquid mixtures with temperature and pressure.
4. Derive and discuss the Wilson equation as a model of solution behaviour for multicomponent system. Discuss the merits of this model over others. Explain its temperature dependence also.
5. Calculate V, H and S for a binary mixture of nitrogen(1) ammonia (2) mixture with $y_1=0.27$ and $y_2 = 0.73$, $t=40^{\circ}\text{C}$ and $P = 325$ bar using Redlich-Kwong equation.
Nitrogen : $T_c = 126.2\text{ K}$; $P_c = 33.9$ bar
Ammonia : $T_c = 405.6\text{ K}$; $P_c = 112.8$ bar.
6. Name the different types of binary mixtures in terms of solubility. What are the critical solution temperatures and the three phase temperature for a partially miscible liquid solution. Show them on diagram.
7. A mixture of N_2, H_2 and Argon in the mole ratio 1:3:2 enters a catalytic reactors for the synthesis of ammonia. The reactor is maintained at 400°C and 20 MPa. Estimate the degree of conversion ($K = 1.96 \times 10^{-4}$)
8. For the system diethyl ketone (1) n-hexane(2), the Margules parameters are $A_{21} = 0.596$ and $A = 1.153$. Using modified Raoult's law, prepare a p-x1-y1 diagram at 65°C . Saturation pressures of DEK and hexane are 29 and 90 kPa respectively.
