Second Semester 2014-2015

CLL121 – Chemical Engineering Thermodynamics – Minor - 2

Time: 60 Minutes Maximum Marks-30(to be scaled down to 15)

1. Liquid methane is to be obtained from its gaseous stream available at 1bar and 300 K. The gas should be brought close to saturation conditions by compression and cooling before it is expanded for liquefaction.
   (a) Discuss the enthalpy of saturated vapor as a function of temperature in the context of optimum conditions for liquefaction.
   (b) Describe the Linde-process with the help of a process flow-diagram, lnP-H diagram and P-T diagram highlighting cooling of compressed gas/vapor in different steps.
   Calculations are not necessary. (5+(4+3+3))
   Useful information: T_c=190.6 K, P_c=46 bar

T,K	P^{sat},bar	H^{l}, kJkg^{-1}	H^{v}, kJkg^{-1}
111.4	1.0133	285.4	796.9
115	1.325	297.1	802.5
130	3.681		824.1
140	6.422		834.8
150	10.41		853.9
160	15.94		843.0
190.6	46.0		704.4

2.Vapor pressure data may be computed with the help of Antoine equation. $\ln P^{sat} = A - B/(T+C)$, vapor pressure in kPa and T in Kelvin.

	A	B	C
Benzene	13.8594	2773.78	-53.08
Toluene	14.0098	3103.01	-53.36

Also, VLE information for benzene- toluene solution may be generated with the help of Raoult's law.
(a) Determine mol fraction of benzene in vapor phase and total pressure for x=0.5 and T=85^{0}C. (b) Determine relative volatility from these data. Generate VLE data assuming the above value of relative volatility. (8+(3+4))