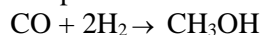


GUJARAT TECHNOLOGICAL UNIVERSITY**ME – SEMESTER I (NEW) – • EXAMINATION – SUMMER 2017****Subject Code: 2711601****Date: 09/05/2017****Subject Name: Advanced Thermodynamics****Time: 02:30 p.m. to 05:00 p.m.****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1 (a) Show that the yield of methanol at $t = 390^\circ\text{C}$, $p = 300\text{ atm}$ is **07**
21% for the reaction proceeds as follows:-



Data: Free Energy change under standard condition at $T = 663.2\text{ K}$
is $+14700\text{ cal/gmol}$ and value of $K_p = 0.434$.

(b) Derive an expression of equilibrium conversion as a function of **07**
temperature.

Q.2 (a) What are equilibrium conversion charts? Elaborate the **07**
procedure for obtaining equilibrium conversion chart. Depict
and discuss generalized nature of these charts for reaction of
type $\text{A} \rightarrow \text{B} + \text{C}$ being **exothermic in nature** and occurring under
different sets of conditions.

(b) Starting from first principals, derive an expression for Heat of **07**
Reaction for a reaction of type $a \cdot \text{A} + b \cdot \text{B} \rightleftharpoons c \cdot \text{C} + d \cdot \text{D}$
occurring at any temperature (T) and any pressure (p) **under**
non-ideal conditions.

OR

(b) Explain the PT flash calculations with block diagram and **07**
supporting equations

Q.3 Explain with neat sketch the working of Vapour compression **14**
refrigeration cycle. Also discuss the importance of
“Economizer” in the same cycle.

OR

Q.3 Explain with neat sketch the working of Ammonia Vapour **14**
absorption refrigeration cycle. Also discuss the importance of
“Economizer” in the same cycle

Q.4 A feed to a column has the composition given in the table below, and **14**
is a pressure of 14 bar and a temperature 60°C . Based on calculations
verify that the given mixture is a Vapour-liquid mixture at given
conditions.

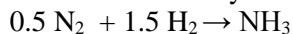
Feed	kmol/h	K_i
ethane	20	3.8
propane	20	1.3
isobutene	20	0.43
n-pentane	<u>20</u>	0.16
Total:	<u>80</u>	

Also determined the flow rates and composition of vapour and liquid
phases.

OR

Q.4 Explain the BUBLT Calculations and DEW T Calculations with block diagram and supporting equations **14**

Q.5 For the ammonia synthesis reaction **14**



With 0.5 mol N₂ and 1.5 mol H₂ as the initial amounts of reactants and with the assumption that the equilibrium mixture is an ideal gas.

Show that

$$\epsilon_e = 1 - (1 + 1.299 K(P/P^0))^{-0.5}$$

where ϵ_e = Equilibrium extent of reaction

P = Absolute pressure

P⁰ = Standard state pressure

K = Equilibrium constant

OR

Q.5 A feed stock of *n* – butane is cracked at 750 K and 1.2 bar to produce olefins. Only two reactions have favorable equilibrium conversions at these conditions. **14**



If these reactions reach equilibrium, what is product composition? At 750 K equilibrium constants for both reactions.

$$K_{\text{I}} = 3.856, \quad K_{\text{II}} = 268.4$$

*****_*****_*****