Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– I (New course)• REMEDIAL EXAMINATION – SUMMER 2015

Subject Code: 2711601 **Date:13/05/2015**

Subject Name: Advanced Thermodynamics

Time: 10:30 am to 1:00 pm **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) Write briefly about criteria of chemical reaction equilibria and standard conditions. Hence or otherwise, discuss about ranges of the following:- **(06)**

(i) ΔG : Free Energy Change for reaction under actual conditions.

(ii) ΔG^o : Free Energy Change for reaction under standard conditions.

(iii) K : Equilibrium constant for chemical reaction equilibria.

(iv) x_e : Equilibrium constant for reaction under actual conditions.

(b) Production methanol proceeds as follows:- **(08)**

$$CO + 2H_2 \rightarrow CH_3OH.$$

The reaction under consideration is carried out at temperature (t) = 390 ^oC and pressure (p) = 300 atm. The value of ratioôs of activity coefficients (Kr) is 0.434 and the value of free energy change for reaction at 663.2 ^oK is + 14,700 Cal/gmole. Show that the values of yield of methanol and equilibrium conversion are 21% and 45% respectively.

Q-(2) (a) Starting from first principals, derive an expression for Heat of Reaction for a reaction of type $a \cdot A + b \cdot B \leftrightarrows c \cdot C + d \cdot D$ occurring at any temperature (T) and any pressure (p) **under non-ideal conditions.** **(07)**

(b) Describe with the help of appropriate data & equations and relevant graphs, the calculation of equilibrium conversion **under adiabatic conditions** for a reaction of type $A \rightarrow B$ being highly reversible and **exothermic in nature.** **(07)**

OR

(b) Describe with the help of appropriate data & equations and relevant graphs, the calculation of equilibrium conversion **under adiabatic conditions** for a reaction of type $A \rightarrow B$ being highly reversible and **endothermic in nature.** **(07)**

Q-(3) (a) Explain calculations of equilibrium conversion values under isothermal conditions for the following **two reactions proceeding simultaneously:** $A \rightarrow B+C$ & $A \rightarrow D+E$. Derive relevant equations for equilibrium constant (K) as a function of P, n_t & x_e. Also briefly decribe stepwise procedure for calculation of values of x_e **when both reactions proceed simultaneously.** **(07)**

OR

(a) Describe with the help of appropriate data & equations and relevant graphs, the calculation of equilibrium conversion **under non-isothermal & non-adiabatic conditions** for a reaction of type $A \rightarrow B$ being highly reversible and **exothermic or endothermic in nature.** **(07)**

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

Q4 For 200 kW (56.87 TR) ammonia water absorption refrigeration plant determine the followings. **(14)**

a. Flow rate of ammonia required in cycle. Consider 2.5 % heat gain.
b. Calculate the heat duty of absorber. Heat of solution of ammonia= 2000 kJ/kg of NH_3
c. Calculate the heat duty of condenser of distillation column. Reflux ratio of distillation column is 0.3137.Condensation temperature of ammonia vapour in condenser = 40 ^oC.
d. Calculate the heat duty of generator (reboiler) of distillation column.
e. Calculate the COP.

DATA:

Temprature,^{o} C	Saturation Pressure,kPa	H_L, **kJ/kg**	H_V, **kJ/kg**
-10	290.75	301.4	1597.8
40	1555.5	538.5	1637.2

OR

Q4 **(a)** Explain with neat sketch the working of Lithium Bromide water Vapour absorption refrigeration cycle. **(07)**

(b) Explain with neat sketch the working of modified Vapour Compression refrigeration cycle. **(07)**

Q5 **(a)** Explain method for DEWT calculation with the help of block diagram and all supportive equations. **(07)**

(b) With Txy and Pxy diagram discuss vapor-liquid-liquid equillibrium. **(07)**

OR

Q5 **(a)** Explain method for DEWP calculation with the help of block diagram and all supportive equations. **(07)**

(b) Explain method for BUBLP calculation with the help of block diagram and all supportive equations. **(07)**