Chemical Engineering Department
College of Engineering
King Saud University

ChE 202 – ChE Principles II

Time= 2 hours **Final Examination** **6/5/1426**

Answer **ALL** questions, Assume any **MISSING** data. Take **Cp=a+b.T**

Question 1

3684 m^3/min of superheated steam at 400 °C and 1 bar is mixed with another stream of saturated steam at 10 bar. The stream exiting the mixer is superheated steam at 350 °C and 5 bar. The mixing unit operates adiabatically. Calculate the required molar flow rate of the 350 °C superheated steam.

Question 2

200 mol/h of a gas mixture of 20% oxygen and 80% nitrogen at 200 °C is mixed adiabatically with another gaseous stream flowing at 100 mol/h at 400 °C and containing 50% of oxygen and 50% hydrogen. Find the temperature of the exit stream. Neglect the kinetic and potential energies and the shaft work required for mixing.

Question 3

(i) Calculate the amount of heat that must be added or removed to cool 100 mol/s of ethanol (C_2H_5OH) from 200 °C to 40°C.

(ii) How much heat should be lost from saturated steam at 77 °C to become saturated liquid at the same temperature

Question 4

The following two reactions take place in a continuous reactor.

$$C_3H_{8(g)} + \tfrac{1}{2}O_{2(g)} \rightarrow C_3H_{6(g)} + H_2O_{(v)}$$
$$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(v)}$$

60 mol/s of propane (C_3H_8) at 25 ºC and 200 mol/s of oxygen at 100 ºC enter the reactor while the products leaves the reactor at 400 ºC. The output of the reactor contains C_3H_6=40 mol/s, CO_2=60 mol/s

(a) Calculate the molar flow rate of C_3H_8, O_2 and H_2O in the exit (output) stream.

(b) Write the reference state you want to use for energy balance.

(c) Construct the Enthaply-Concentration table (n_i , $\hat{H}_i$).

(d) Calculate the amount of heat that must added/removed from the unit.