TE- sem-VI (CBSGS) - chemical - CRE-II
Chemical Reaction Engineering-II 14/12/16

QP CODE : 574400

Duration: 3 hours **Total Marks: 80**

N. B. (i) Question number **one is compulsory.**
(ii) Answer any **three** questions from the rest.
(ii) Assume suitable data wherever necessary.

Q.1.a) Write short note on Fixed bed reactor (05)

b) What is significance of Hatta number in Fluid Fluid reactions? (05)

c) Differentiate between Physical adsorption and Chemical adsorption (05)

d) Define Residence Time Distribution (RTD) and explain significance of E (t) curve. (05)

Q.2.a) An 8.01 gm sample of Glaucosil is studied with N_2 adsorption at -195.8°C. The following data are obtained: (12)

Pressure, mmHg	6	25	140	230	285	320	430	505
Volume adsorbed, cm^3(at 0°C & 1 atm)	61	127	170	197	215	230	277	335

The vapor pressure of N_2 at -195.8°C is 1 atm. Estimate the surface area in m^2/gm of the sample. The density of N_2 is 0.808 gm/cc.

b) Write short note on Slurry Reactor (08)

Q.3a) A batch of solids of uniform size is treated by gas in a uniform environment. Solid is converted to give a non flaking product according to the shrinking core model. Conversion is about 7/8 for a reaction time 1 hr., conversion is complete in 2 hours. What mechanism is rate controlling? (10)

b) Write short note on the reactors used for solid –fluid non catalytic reactors. (10)

TURN OVER

Q.4) We plan to remove 90% of an undesirable impurity (A) present in a gas stream by absorption in water containing reactive B in a packed tower. (20)

A and B reacts in the liquid as follows:

$A\ (g \longrightarrow l) + B\ (l) \longrightarrow R\ (l), \quad -r_A = kC_AC_B$

Determine the volume of tower needed for countercurrent operation using the following data

$F_g = 90000$ mol/h at $\pi = 10^5$ Pa , $P_{A\ in} = 1000$ Pa, $P_{A\ out} = 100$ Pa

$F_l = 900000$ mol/h, $C_{B\ in} = 55.56$ mol/m^3

$k_{Ag}a = 0.36$ mol/(h.m^3.Pa), $k_{Al}a = 72$ h^{-1}, $a = 100$ m^2/m^3

$f_l = (V_l/V) = 0.08$, $D = 3.6 \times 10^{-6}$ m^2/h

$C_U = 55556$ mol H_2O/m^3 liquid, at all C_B

$H_A = 10^5$ (Pa.m^3)/mol and $k = 2.6 \times 10^7$ m^3/(mol.h)

Q.5) A tracer with number of dividing baffles is to be used to carry out the reaction $A \rightarrow R$ .The results of a pulse tracer test are given below (20)

t, min	0	4	8	12	i2	16	20	24
Traceroutput Concentration (mg/l)	0	3	5	5	4	2	1	0

a) Plot C (t), E (t) and F (t) curves.

b) Calculate mean residence time.

c) Calculate Variance and standard deviation.

d) Find the fraction of material that has spent time between 4 and 8 min in the reactor

Q.6.a) In a Plug Flow Reactor, CO & H_2 are passed over Ni catalyst to generate methane. (15)

$CO + 3H_2 \longleftrightarrow CH_4 + H_2O$

The rate equation is

$$-r' = \frac{1.1P_{CO}P_{H_2}^{0.5}}{1 + 1.5P_{H_2}}, mol/(gcat.h)$$

The reaction is carried out under isothermal conditions at one atmosphere. CO and H_2 are fed in stoichiometric proportion with 1 mol/h of CO. Calculate the amount of catalyst required for 20% conversion of CO.

Data: Bulk density of catalyst = 480 kg/m^3

b) Explain Tanks in series Model. (05)
