B.TECH. SEM -VI (CHEMICAL 2014 COURSE (CBCS) :
SUMMER - 2018

SUBJECT: CHEMICAL REACTION ENGINEERING - II

Day: **Wednesday** **S-2018-2387** Time: **02.30 PM TO 05.30 PM**
Date: **06/06/2018** Max. Marks: 60

N.B.:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.

Q.1 Derive the relation for unreacted core model for spherical particle when chemical reaction controls. **(10)**

OR

Q.1 On doubling the particle size from R to 2R the time needed for conversion of a particle triples. Determine the contribution of ash diffusion resistance to the overall resistance for particle of size: **(10)**
i) R and ii) 2R. Neglect gas film resistance.

Q.2 **a)** Draw concentration profile for mass transfer with chemical reaction for all types of reaction. **(05)**

b) It is proposed to remove CO_2 from air by counter current contact with water at 25^0C. **(05)**
i) What are the resistances of the gas and liquid films for this operation?
ii) Suggest simplest form of rate equation for tower design.
Data=
K_{Aga}= 0.01 mol/ hr.m^3 pa.
K_{Ala} = 20hr^{-1}
H_A = 10^5pa. m^3 /mol.

OR

Q.2 The concentration of an undesirable, impurity A in air $\left(\text{at}\,\pi = 1\,bar = 10^5\,pa\right)$ is to be reduced from 01% to 0.02% by absorption in pure water. Estimate the height of tower needed for countercurrent operation. **(10)**
Data = $K_{Ag}a$ = 0.32 mol / (h m^3.pa)
$K_{Al}a$ = 0.10 h^{-1}
The solubility of A in water is given by Henry's law constant:
H_A = 12.5 (Pa.m^3/ mol)
The flow rates of gas and liquid per m^2 of tower cross section are
$F_g / A_{Cs} = 1 \times 10^5$ mol / (h.m^2)
$F_l / A_{Ca} = 7 \times 10^5$ mol/ (h.m^2)
The molarity of liquid under all conditions is C_T = 56000mol/m^3.

Q.3 **a)** Explain mechanism of catalytic reaction. **(05)**

b) Explain Langmuir adsorption isotherm in detail. **(05)**

OR

Q.3 The reaction sequence for decomposition of cumene is as follows: **(10)**

$$C + S \underset{k_{-A}}{\overset{k_A}{\rightleftharpoons}} C.S$$

$$C.S \underset{k_{-S}}{\overset{k_S}{\rightleftharpoons}} B.S + P$$

$$B.S \underset{k_{-D}}{\overset{k_D}{\rightleftharpoons}} B + S$$

Find the rate expression when adsorption is rate limiting.

P. T. O.

Q.4 How much catalyst is needed in a packed bed reactor (assume plug flow) for 35% conversion of A to R for a feed of 2000 mol/h of pure gaseous A t 3.2 atm and 117^{0}C if the stoichiometry and rate are given by **(10)**

$$A \rightarrow 4R, \quad -r_{A'} = 96.55\left(\frac{l}{h.kg.cat}\right)C_A \ .$$

C_{A0} = 0.1 mol/ lit $\in$= 3 .

OR

Q.4 The catalytic reaction $A \rightarrow 4R$ is run at 3.2 atm and 117^{0}C in a plug flow reactor which contains 0.01kg of catalyst and uses a feed consisting of the partially converted product of 20 lit/ hr of pure unreacted A. The results are as follows: **(10)**

Run	1	2	3	4
C_{Ain} mol/lit	0.100	0.080	0.060	0.040
C_{Aout} mol /lit	0.084	0.070	0.055	0.038

Find the rate equation to represent this reaction.

Q.5 Derive the relation for diffusion and reaction in spherical catalyst pellet. **(10)**

OR

Q.5 Write notes on: **(10)**

i) Internal effectiveness factor
ii) Chemical vapor decomposition reactors.
iii) Mass transfer and reaction in packed bed

Q.6 The data given below represents a continuous response to a pulse input into a closed vessel which is to be used as a chemical reactor. **(10)**

Calculate the mean residence time of fluid in the vessel $\bar{t}$, and tabulate and construct E curve

t, min	0	5	10	15	20	25	30	35
C_{Pulse}. g/l tracer output cone)	0	3	5	5	4	2	1	0

OR

Q.6 a) What is the role of RTD in determining reactor behavior? **(05)**

b) Explain step and pulse experiment. **(05)**

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