

Total No. of Question : [4]

Registration No. :

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Programme Name : Bachelor of Chemical Engineering
Regular B.Tech.Final Year (A.Y.2023-24) ESE Sem. VII Nov.2023
VII SEMESTER (2020 BATCH)
201CHL401-Chemical Reaction Engineering II (TH)

Duration : [02:00 PM - 04:00 PM]

Date : 21 Nov, 2023

Day : Tuesday

Marks : 50

Instructions :

1.Read questions carefully.

(Q1) All Questions are compulsory

[20.0]

(1.1) Discuss in detail about Tank In series model and derive relation for it.

[6.0]

CO :- C401.3

Blooms Taxonomy :- Apply

OR [1.1 / 1.2]

(1.2) An 8.01 gm sample of Glucosil is studied with N₂ absorption at - 195.8⁰ C

[6.0]

Pressure, mm Hg	6	25	140	230	285	320	430
Volume absorbed, cm ³ at 0 ⁰ C and 1 atm.	61	127	170	197	215	230	277

The Vapour pressure of N₂ at - 195.8⁰ C is 1 atm. Estimate surface area in square meter per gram of sample.

CO :- C401.3

Blooms Taxonomy :- Apply

(1.3) Derive expression for macro fluid in MFR.

[7.0]

CO :- C401.2

Blooms Taxonomy :- Apply

(1.4) 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 .Calculate the variance of the fluid in the vessel and tabulate a constant E values & plot E curve. [7.0]

t, min.	0	5	10	15	20	25	30	35
C _{pulse} (gm/lit.)	0	3	5	5	4	2	1	0

CO :- C401.1

Blooms Taxonomy :- Apply

(Q2) All Questions are compulsory [10.0]

- (2.1) Derive the conversion-time expression for non-catalytic solid-fluid reaction $A(\text{gas}) + bB(\text{solid}) \rightarrow \text{Product}$, when diffusing through chemical reaction control the overall reaction for un-reacted core model. [4.0]

CO :- C401.4

Blooms Taxonomy :- Apply

- (2.2) A batch of spherical solids (of single size, i.e., of uniform size) is treated by gas in a uniform environment. Solid is converted to a firm non-flaking product according to the shrinking core model (SCM). The conversion is 87.5 % in a reaction time of 1 h and is complete (100 %) in 2h. Determine the rate of controlling step. [6.0]

CO :- C401.4

Blooms Taxonomy :- Apply

(Q3) All Questions are compulsory [10.0]

- (3.1) The concentration of an undesirable impurity A in air is to be reduced from 0.1 to 0.02 % by absorption in reactive liquid which contains a high concentration of reactant B, $C_{B1} = 800 \text{ mol/m}^3$. Find the height of tower for required for counter current operations. Assume $K_{A1} = K_{B1} = K_I$ [4.0]

The reaction $A(\text{gas}) + B(\text{liquid}) \rightarrow \text{products}$, takes place in the liquid and is extremely rapid.

Data: $K_{Ag} = 32000 \text{ mol/hr m}^3 \cdot \text{atm}$

$K_{Al} = 0.1/\text{hr}$

$H_A = 125 \times 10^{-6} \text{ atm/m}^3 \cdot \text{mol}$.

$L = 7 \times 10^5 \text{ mol/hr m}^2$

$G = 1 \times 10^5 \text{ mol/hr m}^2$

$C_r = 56000 \text{ mol/m}^3$.

CO :- C401.5

Blooms Taxonomy :- Apply

- (3.2) Explain absorber (tower) design with chemical reaction for gas-liquid reactions. [6.0]

CO :- C401.5

Blooms Taxonomy :- Apply

(Q4) Attempt any two out of three questions [10.0]

- (4.1) The catalytic reaction $A \rightarrow 4R$ is run at 3.2 atm and 117 °C in a plug flow reactor which contains 0.01 kg of catalyst and uses a feed consisting of the partially converted product of 20 liters/ hr of pure un-reacted A. The results are as follows: [5.0]

$C_{Ain} \text{ mol/liter}$	0.100	0.080	0.060	0.040
$C_{Aout} \text{ mol/liter}$	0.084	0.070	0.055	0.038

Find a rate equation to represent this reaction.

CO :- C401.6

Blooms Taxonomy :- Apply

- (4.2) Derive expression for batch solid & mixed constant flow of fluid for deactivating catalyst. [5.0]

CO :- C401.6

Blooms Taxonomy :- Apply

- (4.3) Explain the term catalysis. Discuss the mechanism and regeneration of deactivating catalyst. [5.0]

CO :- C401.6

Blooms Taxonomy :- Apply
