TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY (INDUSTRIAL OPTION)

BTAC 12S SEPT 2012

ACH 4409 REACTOR DESIGN

END OF SEMESTER EXAMINATION

SERIES:MAY 2016

TIME:2 HOURS

DATE:

Instructions to Candidates

You should have the following for this examination

-*Answer Booklet, examination pass and student ID*

This paper consists of FIVE questions. Attempt Question one compulsory and any other two question

Do not write on the question paper.

Paper one

QUESTION ONE

A. Discuss the causes of deviation in ideal packed bed reactor **4 marks**

B. State :-
   i. advantages of Semi-Batch Operation **4 marks**
   ii. Disadvantages of Fluidized bed reactors. **4 marks**

C. Sketch the concentration- time trajectory for the reaction $C_{AO} = 4mol/L$, $C_{BO} = 6m0l/L$ $C_{C0} = C_{DO} = 0mol/L$ **3 Marks**

D. The BP of benzene at 101325 Pascal is 353.25 K. determine the pressure at which benzene will boil at 298.15K, Given standard enthalpy of vaporisation as 30.8 kJ mol^{-1}. **4 marks**

E. With the help of rate equation Show how selectivity of the following reaction can be maximise **4 marks**

$$A \xrightarrow{k_D} D \quad \text{(desired)}$$

$$A \xrightarrow{k_U} U \quad \text{(undesired)}$$

F. Using general mole balance equation, show

i. that the design equation for a plug flow reactor is

$$V_{PFR} = FAO\int_{O}^{X_A} \frac{dx_A}{-\lambda A}, \quad \varepsilon_A = O$$

5 Marks

ii. graphically how space time of a plug flow reactor can be determined **2 Marks**

QUESTION TWO

A. Define minimum fluidization velocity **2 Marks**

B. Discuss different factors affecting performance of Packed bed Reactor **5 marks**

C. Use Algorithm methode to write the net rate law of specis A and C in the following multiple reaction taking place in plug flow Reactor.

I A + 2B → C

II 2A + 3C → D **5 Marks**

D. The rate of the gas phase reaction between H_2 and I_2 is 2.5 x 10^{-3}L/mols at 630K under a total pressure of 1atmp. Assuming the activation energy for the reaction as 163 kJ/mol, calculate the collision frequency between H_2 and I_2. **5 Marks**

E. State characteristic of ideal Batch Reactor **3 Marks**

QUESTION THREE

A. with the aid of a diagram explain the operation features of Fluidised bed Reactor **6 Marks**

B. Reactant A C_{AO} = 100milimol flow into mixed reactor of volume V = 0.1L. dimerises by reactioin 2A ⟶ R. Calculate fractional conversion of A when initial concentration reduces to 66.7milimol. **4 marks**

C. Discuss plug flow pattern assumptions **3 marks**

D. Outline characteristic of the ideal continuous stirred tank reactor (CSTR **3 Marks**

E. Define (i) Complex Reaction (ii)Series reactions **4 mark**

QUESTION FOUR

A. Differentiate between Fixed Bed Reactor and Fluid Bed Reactor **4 marks**

B. Outline different steps used to design chemical reactors **4 Marks**

C. Define four types of catalytic Reactors **5 marks**

D. 1L/minutes of liquid contain A and B (C_{AO} = 0.1mol/L, C_{BO} = 0.01mol/L) flow into mixed reactor of volume V = 1L. Outlet stream from reactor contains A, B, and C (C_{AF} = 0.02mol/L), C_{BF} = 0.03mol/L and C_{CF} = 0.04) find the rate of reaction of A, B, C for conditions within reactor. **6 marks**

QUESTION FIVE

A. State the Aplications, advantages and disadvantages of Tubuler Reactor **6 marks**

B. The solubility product constant of calcium hydroxide was measured at several temperatures, as given below. Using van't Hoff plot , determine the value of Enthalpy change and Entropy change ΔH^o and ΔS^o. **10Marks**

Temperature in ^{0}C	10	20	30	40	50	60	70	80	90
ln K_{sp}	–12.11	-12.25	-12.65	-12.82	-12.90	-13.17	-13.41	-13.41	-13.63

C A gas mixture consist of 2moles of A and 2 moles of B at 10 atmospheric pressure enter the CSTR reactor with flow rate of 6dm^3 /seconds at 422 kelvin the following data were obtained. calculate the volume necessary to achive 70%conversion in CSTR **4 marks**
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Fractional conversion X_A	0.0	0.2	0.6	0.7	0.8	0.85
Rate of reaction $-r_A$ (10^{-3})	5.3	5	2.5	1.8	1.25	1.0