NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF SECOND SEMESTER EXAMINATIONS – MAY 2004
REACTOR TECHNOLOGY – SCH 4208
TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES

Answer **All** questions from Section A and **ANY THREE** questions from Section B.

Section A -40 marks

1. Show that the relation for volumes for a tank reactor and tube reactor are given by the following expressions for;

(a) irreversible 1st order reaction
$V_{tank}/V_{tube} = X/(1-X)\ln(1/1-X)$ (6marks)

(b) irreversible 2nd order reaction
$V_{tank}/V_{tube} = 1/(1-X)$ (6marks)

2. Explain with the aid of a diagram one of the models in which reaction within a particle manifests. (6marks)

3.(a)What factors must one consider when designing a catalytic reactor? Discuss (6marks)

3.(b) Explain what type of reactor is mostly preferred if the initial rate of heat evolution is very high. (4marks)

4. (a)Describe methods which you can use to control the temperature in a batch reactor whose reaction is exothermic. (6marks)

4. (b) Determine the time taken to effect a 80% conversion on a 1st order reaction whose rate constant is $0.00678min^{-1}$.(6marks)

5. Distinguish between an elementary and nonelementary reaction, citing examples. (12marks)

Section B- 60marks

6. The 1st order reaction A→R is carried out isothermally in a batch reactor. At t=0, Na=Nao=1gmole. The rate constant $k=3hr^{-1}$,
(a)Use a time step h=0.2hr to compute the moles of A present at the end of the 1st time step t=0.2hr and at t=0.4hr. (12marks)
(b)Compare the result found in (a) with that given by the exact solution. (8marks)

7. With the aid of sketch diagrams explain the mode of operations and industrial applications of a fluidized bed reactor and bubble cap column reactor. (20marks)

8.Determine the fractional conversion of reactant whose flow rate into $2.5m^3$CSTR is $0.250m^3min^{-1}$. The initial concentration is $400mol/m^3$ and the conversion reaction is 2nd order with a rate constant of 180liter/(mol.hr). (20marks)

9.The concentration of an undesirable impurity A in air is to be reduced from 0.15% to 0.025% by absorption in acid solution B with concentration $C_B=0.065gmole/m^3$. The reaction is A(g) + B(l) → products(l) takes place in the liquid phase and is rapid and the products remain in the liquid phase and for packing used:
$k_{Ag}a = 2.5gmol/(hr(m^3)(atm)$
$k_la = 0.15/hr$
The flow rates are 140gmoles/hr(L^1) for the liquid and 20gmoles/hr for the gas(G^1) at π=1atm. Molar density of liquid is $3.5gmol/m^3$. Find the height of the tower required for countercurrent absorption. (20marks)

END OF QUESTION PAPER!!!!