UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualifications:-

B.Eng. *M.Eng.*

Chemical Eng E836: Chemical Reaction Engineering

COURSE CODE	:	**CENGE836**
UNIT VALUE	:	**0.50**
DATE	:	**21-MAY-03**
TIME	:	**10.00**
TIME ALLOWED	:	**3 Hours**

03-C0185-3-60

TURN OVER

***Answer 4 out of 5 questions.* Only the first four answers will be marked.**
ALL questions carry a total of 25 each, distributed as shown [ ]

1.

Reactant A produces R and S in the liquid phase by a parallel reaction scheme. The reaction to R is 2 nd order and the reaction to S is 1 st order. The feed (C_{Ao} = 1 mol/m^3, $C_{Ro} = C_{So}$ = 0 mol/m^3) enters two CSTRs in series (τ_1 = 2.5 min, τ_2 = 10 min). Knowing the concentrations in the first reactor (C_{A1} = 0.4 mol/m^3, C_{R1} = 0.4mol/m^3, C_{S1} = 0.2 mol/m^3), find the concentrations of A, R and S in the outlet of the second reactor. [25]

2.

Consider an elementary, liquid phase irreversible reaction A→B. Pure, liquid reactant A enters a CSTR with a volumetric flowrate 2.52 x 10^{-6} m^3/min and temperature 20°C. After that it flows to a PFR connected in series with the CSTR. The conversion of A at the exit of the PFR is 97%. Both reactors operate adiabatically. Calculate the volume of the PFR if the volume of the CSTR is 0.378 m^3. Additional information: ΔH^o_R=-0.4 kJ/g, $c_{pA}=c_{pB}$ = 2 J/g K, $k = 7.25\times10^{10} e^{(-14570/T)}$ s^{-1} (T is in K). [25]

3.

The elementary, liquid phase reaction

$$A+B \rightarrow P$$

with a rate constant k = 5.2 dm^3/ mol h, is taking place in a continuous reactor. The initial concentrations are $C_{Ao} = C_{Bo}$ =1.23 mol/dm^3.

a) What is the volume of a PFR required if a 95% conversion of A and a production of P equal to 322 mol/h are desired?

b) What is the volume of a CSTR required for the same inlet and outlet conditions as above? [25]

4.

The irreversible, elementary gas phase reaction 2A→2B is carried out isothermally in a fluidised catalyst reactor which behaves as a CSTR and contains 100kg of catalyst. 50% conversion is obtained for pure A entering at a pressure of 20 atm. There is virtually no pressure drop in the fluidised reactor. It is proposed to use a fixed bed reactor containing the same catalyst weight immediately after the fluidised bed reactor. The pressure drop parameter is α = 0.009 kg^{-1}. What is the conversion of the reaction mixture exiting the fixed bed reactor? [25]

PLEASE TURN OVER

5.

This question concerns biocatalytic reactor kinetics.

a) Derive the expression (based on a material balance) to describe the productivity of a batch stirred tank reactor. State the assumptions used. [15]

b) Why is this type of reactor preferable for industrial operation than a plug-flow reactor or a continuous stirred tank reactor? [5]

c) For industrial operation why is the batch stirred tank usually used in fed-batch mode? [5]

END OF PAPER