I.F.S-2009

313

B-JGT-J-DIFB

CHEMICAL ENGINEERING

Paper II

Time Allowed : Three Hours | *Maximum Marks : 200*

INSTRUCTIONS

Candidates should attempt questions no. 1 and 5 which are compulsory, and any THREE of the remaining questions, selecting at least ONE question from each Section.

The number of marks carried by each question is indicated at the end of the question.

Answers must be written in ENGLISH.

Assume suitable data, if considered necessary, and indicate the same clearly.

Symbols and notations have their usual meanings.

Neat sketches may be drawn, wherever required.

SECTION A

1. Answer any *four* of the following (maximum 150 words each) : *4×10=40*

(a) Explain about excess air requirement and adiabatic flame temperature.

(b) Distinguish between an ideal mixed flow reactor and an ideal plug flow reactor. In which reactor will you get better conversion ? Write down the design equation of each ideal reactor.

(c) Compare and illustrate the interpretation of kinetic data by integral method of analysis with that of differential method of analysis.

(d) Pure oxygen is mixed with air to produce an enriched air containing 50% by volume of oxygen. Determine the ratio of air to oxygen used.

(e) Explain about temperature effects and runaway reactions.

2. (a) Explain about recycle, bypass, purge and Kopp's Rule. *10*

(b) The analysis of gas entering the secondary converter in a contact sulphuric acid plant is 4% of SO_2, 13% of O_2 and 83% N_2 (volume basis). In a converter SO_2 is oxidised to SO_3. The gases leaving the converter contain 0·45% SO_2 on SO_3 free basis. Calculate % conversion of SO_2. *20*

(c) An aqueous solution of 2·45% by weight sulphuric acid, has a specific gravity of 1·011. Express the composition of sulphuric acid in normality. *10*

3. (a) If the density of gaseous ammonia at 473 K and 50 bar is 24·3 kg/M^3, estimate its fugacity. *20*

(b) Calculate the fraction of pure ethane that would dehydrogenate at 750 K and 5 atm, if the following reaction takes place at equilibrium :

$$\Delta G_{750\ K} = 42{\cdot}576\ kJ.$$ *20*

4. (a) Find the first order rate constant for the disappearance of A in the gas reaction $2A \rightarrow R$ if, on holding the pressure constant, the volume of reaction mixture, starting with 80% A, decreases by 20% in 3 minutes. *20*

(b) A gaseous feed of pure A (one mole/litre) enters a mixed flow reactor of 2 litres volume and reacts as follows :

$$2A \rightarrow R \quad -r_A = 0{\cdot}05\, C_A^2 \text{ mole/litre-sec.}$$

Find what feed rate will give an outlet concentration of $C_A = 0{\cdot}5$ mole/litre. *20*

SECTION B

5. Answer any ***four*** of the following (maximum 150 words each) : *4×10=40*

(a) Explain about atmospheric distillation of crude oil.

(b) Explain about edible oils extraction. Compare and contrast Soaps vs. Detergents.

(c) Explain about the reason for ozone layer depletion and acid rain.

(d) Discuss about solid wastes hazards and their disposal techniques.

(e) Explain about net present value by discounted cash flow.

6. (a) Give an account of coal chemicals. *15*

(b) Discuss manufacture of ammonia (NH_3) with a neat flow sheet. *15*

(c) Explain how poly vinyl chloride is manufactured. *10*

7. Explain the extent of environmental legislation in the country. Bring out the specific features relevant to water and air protection and those relating to forest conservation. *40*

8. (a) Discuss about the estimation methods of fixed and working capital requirement for a process industry. *20*

(b) Explain about HAZOP and HAZAN. *20*