PG/IIS/CEM-204/13

M.Sc. 2nd Semester Examination, 2013

CHEMISTRY

PAPER—CEM - 204

Full Marks : 40

Time : 2 hours

Answer any **four** questions

The figures in the right-hand margin indicate marks

Provide mm graph papers wherever required

1. (*a*) Define manufactured fuels with example.

   (*b*) What is the significance of octane number.

   (*c*) What is the significance of volatile matter in coal ?

   (*d*) Define carbonization. Differentiate between HTC and LTC. 2 + 2 + 2 +4

2. (*a*) Why pretreatment of petroleum crude is necessary ?

(*b*) What is fractional distillation ?

(*c*) What is reforming ?

(*d*) Describe Bergius process. 2 + 2 + 2 +4

3. At room temperature sucrose is hydrolyzed by the catalytic action of the enzyme sucrase as follows :

$$\text{Sucrose} \xrightarrow{\text{Sucrase}} \text{products}$$

Starting with a sucrose concentration, $C_{Ao} = 1{\cdot}0$ millimol/lit and an enzyme concentration, $C_{Eo} = 0{\cdot}01$ millimol/lit, the following kinetic data are obtained in a batch reactor :

C_A (millimol/lit)	0·84	0·68	0·53	0·38	0·27	0·16	0·09	0·04	0·018	0·006	0·0025
t(hr)	1	2	3	4	5	6	7	8	9	10	11

Determine whether these data can be reasonably fitted by a Kinetic equation of the Michaelis-Menten type or :

$$-r_A = \frac{K_3 C_A C_{Eo}}{C_A + M}$$

where, M is Michaelis constant. If the fit is reasonable evaluate the constants K_3 and M. 10

4. We are planning to operate a batch reactor to convert A into R. This is a liquid reaction, the stoichiometry is :

$$A \longrightarrow R$$

and the rate of the reaction is given in the following table :

C_A in (mol/lit)	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	1·0	1·3	2·0
$-r_A$ in mol/lit.min	0·1	0·3	0·5	0·6	0·5	0·25	0·10	0·06	0·05	0·045	0·042

How long must we react each batch for the concentration to drop from C_{Ao} = 1·3 mol/lit to C_{Af} = 0·3 mol/lit ? 10

5. (*a*) Explain how integral analysis of a kinetic data set is carried out.

(*b*) Derive the design equations for constant volume and variable volume batch reactors.

(*c*) In a homogeneous isothermal liquid polymerization, 20 % of the monomer disappears in 34 min for initial monomer concentration of 0·04 and also for 0·08 mol/lit. What is the rate of disappearance of the monomer ? 3 + 4 + 3

6. (*a*) Derive Fick's first law of diffusion.

(*b*) Formulate inter-phase mass transfer for an immiscible liquid-liquid system using the equilibrium relationship :

$$C_{A1i} = mC_{A2i}$$

where C_{A1i} is the interface concentration of the diffusing component A in the liquid phase 1 and C_{A2i} is the same in the liquid phase 2.

(*c*) What is overall mass transfer coefficient ? 3 + 5 + 2
