

Total No. of Printed Pages—5

8

PAR/CCM-11/13

CHEMICAL ENGINEERING 2014

FIRST PAPER

Full Marks : 200

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Answer any **five** questions

1. (a) With a neat flow sheet, describe the operation of a 2-stage distillation column for the separation of different petroleum fractions from crude oil. 20
- (b) What are detergents? Name different types of detergent. 5
- (c) Write the difference between thermosetting and thermoplastic polymers. 5
- (d) Classify different types of chemical reactor. 10
2. (a) What is a Mollier chart? Explain the parameters shown by this chart. How are they useful in thermodynamic calculations? 10

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(Turn Over)

- (b) What are the most popular pulping methods used in pulp and paper industries? Describe any one of these processes with a flow diagram. 4+6=10
- (c) What is the purpose of catalytic reforming in a refinery? What are the major reactions involved in the reforming process? 5+5=10
- (d) Describe a 'ball mill'. 10
3. (a) What are the methods of extracting vegetable oils? How is it purified? 10
- (b) Write in brief what you mean by—
(i) chemical equilibrium;
(ii) reversible and irreversible processes. 5+5=10
- (c) What is synthesis gas? Describe a process for the manufacture of synthesis gas. 10
- (d) What are the different types of size reduction equipment? Write briefly on the principle of any one of them. 10
4. (a) Give the classification of polymers. Mention about their uses in brief with suitable examples. 10

- (b) What is activation energy? How is it related to the possibility, the rate and the energy demands of a reaction? Which famous equation highlights activation energy? $4+4+2=10$
- (c) A second-order reaction carried out in a single CSTR results in 80% conversion. It is proposed to arrange another similar CSTR in series with the first one. How will this addition affect the conversion of reactants? Explain. 10
- (d) Mention two equipments that can be used for separation of solids from gas. Explain the working principle of any one of them. 10
5. (a) What are the different methods for determining rate expressions? Write their merits and demerits. 10
- (b) "Screen analysis provides us with vital information on physical properties of a mixture or variable size materials." Explain this statement. Mention the most important uses of screening. What are the differences between differential analysis and cumulative screen analysis? $5+5=10$

(c) Give the general characteristics of a fermentation process. How is air sterilization carried out? 10

(d) Derive the following relationship :

$$\left[\frac{\delta C_P}{\delta P} \right]_T = T \left[\frac{\delta^2 V}{\delta T^2} \right]_P$$

and hence show that

$$\left[\frac{\delta C_P}{\delta P} \right]_T = 0$$

for an ideal gas. 10

6. (a) Give at least two uses of each of the following : 2×5=10

- (i) Polyethylene
- (ii) Polypropylene
- (iii) Polyvinyl chloride
- (iv) Acrylics
- (v) Urea formaldehyde

(b) Explain the importance of RTD in evaluating the performance of a reactor. 5

(c) What is a tracer? What should be the characteristics of a 'tracer'? 5

(5)

- (d) Find the missing terms in the following four basic thermodynamic equations :

$2\frac{1}{2} \times 4 = 10$

(i) $dE = \text{---} - P.dV$

(ii) $dH = T.dS + \text{---}$

(iii) $\text{---} = - P.dV - S.dT$

(iv) $dE = V.dP - \text{---}$

- (e) Brahmaputra Crackers and Polymers Ltd. (BCPL), being set up near Dibrugarh, is expected to change the industrial scenario of Assam. Discuss how a petrochemical complex can contribute to the industrial growth of a region.

10

7. Write short notes on any *five* of the following :

$8 \times 5 = 40$

- (a) Froth flotation process
- (b) Thermodynamic scale of temperature
- (c) Basic properties of catalysts
- (d) Solid conveying
- (e) Clausius-Clapeyron equation
- (f) Difference between LDPE and HDPE
- (g) Composition of petroleum
- (h) Rotary drum filter
