[This question paper contains 4 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **1404** **I**

Unique Paper Code : 6092011103

Name of the Paper : Unit Operations

Name of the Course : **B.Sc.(H) Polymer Science (UGCF)**

Semester : I

Time : 3 Hours ***Maximum Marks : 90***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Scientific calculator is allowed.

(c) Attempt **six** questions in **all.**

(d) Question No. **1** is compulsory.

1. (a) What is the purpose of material and energy balance ?

(b) Discuss the role of diffusion in mass transfer.

(c) Write short note on air cooled heat exchanger.

P.T.O.

(d) Discuss Schmidt number and its significance.

(e) Explain Reynolds number.

5×3=15

2. (a) Write short note on azeotropic distillation.

(b) The gas acetylene is produced according to the following reaction by treating calcium carbide with water :

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$$

Calculate the number of hours of service that can be derived from 1.0 kg of carbide in an acetylene lamp burning 60 litres of gas per hour at a temperature of 20°C and a pressure of 740 mm Hg.

(c) What is size reduction. Discuss the working principal of ball-mill and its construction.

3+7+5=15

3. (a) Discuss the Henry law and its limitation in details.

(b) What is mass transfer phenomenon ? Discuss the 'Two film theory' in details.

(c) Dry methane is burned with dry air (both are initially at 25°C). The flame temperature is 1297°C. If complete combustion is assumed, how much excess air is to be used ?

Data:

Heat of reaction $\Delta H_R = -0.2 \times 10^6$ cal.

Cp for CO_2 = 12.37 cal/mol°C

Cp for H_2O = 9.60 cal/mol°C

Cp for N_2 = 7.68 cal/mol°C

Cp for air = 7.74 cal/mol°C

3×5=15

4. (a) What is an adsorption isotherm ? Discuss the various applications of adsorption in details.

(b) What is drying ? Illustrate the different stages of drying of moist solid.

(c) Discuss different types of unit operation used in polymer synthesis industry.

3×5=15

5. (a) What is diffusion ? Describe the Fick's law of diffusion.

(b) Discuss the plate type heat exchanger with suitable diagram.

(c) A producer gas with the composition by volume, 27.3% CO, 5.4% CO_2, 0.6% O_2, 66.7% N_2 is burnt with 20% excess air. If the combustion is 98% complete, calculate the composition by volume of the flue gases.

3×5=15

6. (a) What are condensers and vaporizers ? Discuss two-pass floating-head condenser in detail.

(b) Discuss the penetration theory in details.

(c) What is crusher ? Discuss smooth roll crusher in details.

3×5=15

7. (a) What is filtration ? Discuss factors which affect rate of filtration.

(b) Explain Langmuir theory of adsorption.

(c) Discuss the double-pipe heat exchangers.

3×5=15

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