

Total No. of Questions : 12]

SEAT No. :

P1115

[4659] - 319

[Total No. of Pages : 3

B.E. (Polymer Engineering)
c - POLYMER REACTION ENGINEERING
(2008 Course) (Elective - I) (409364)

Time : 3 Hours]

[Max. Marks : 100

Instructions to the candidates:

- 1) *Answers to the two sections should be written in separate books.*
- 2) *Draw neat diagrams wherever necessary.*
- 3) *Numbers to the right indicate full marks.*
- 4) *Assume suitable data, if necessary.*
- 5) *Use of logarithmic table, electronic pocket calculators is allowed.*

SECTION - I

- Q1) a)** Discuss the following quantities **[8]**
- i) First moment of P_j 's
 - ii) Zeroth moment of P_j 's and show that First moment of P_j 's = M^0 -M.
- b) Discuss the importance of molecular weight and Molecular weight distribution of polymer. Explain the distinctive features of Polymer Reaction Engineering. **[10]**

OR

- Q2) a)** Explain the following quantities to be used in the Characterization of Long Chain Molecules: **[12]**
- i) Weight Fraction,
 - ii) First moment of P_j 's
 - iii) Number Average Degree Of Polymerization
 - iv) Weight Average Degree Of Polymerization
 - v) Number Average Molecular Weight
 - vi) Weight Average Molecular Weight

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- b) Find the Number average, weight average Molecular weight and polydispersity Index of the given mixture which is composed of 1 molecule of 10,000 monomer lengths and 19 molecules of 20,000 monomer lengths and 25 molecules of 2000 monomer lengths. [6]

Q3) a) Discuss the mechanism of Ionic polymerization and derive the necessary expression for Instantaneous Fractional Degree of Polymerization and Instantaneous weight Degree of Polymerization by using Ionic polymerization. [10]

- b) Discuss all the mechanism steps to be used in Free radical polymerization. [6]

OR

Q4) In a batch reactor by using Benzoyl peroxide as an Initiator polymerization of monomer (styrene) is carried out at 60°C. The initial concentration of monomer is 18 gmole/lit, and the concentration of initiator is kept constant at 0.05 gmole/lit. Assume termination takes place only by combination. The rate constant are as $K_0 = 5 \times 10^{-7} \text{ sec}^{-1}$, $k_p = 106 \text{ lit/gmole.sec}$, $k_c = 2.6 \times 10^7 \text{ lit/gmole.sec}$, $f = 0.6$. Find the percentage conversion, Instantaneous Number Degree of Polymerization, Number Average molecular weight for a reaction time of 4800 sec. [16]

Q5) a) Describe with neat diagram role of Critical Micelles Concentration. [6]

- b) Describe the Three Stages of Emulsion Polymerization needed to understand the kinetics. [10]

OR

Q6) a) Discuss the necessary equation for the steady state population balance equation for the particles having 'n' radicals in the Emulsion polymerization. [10]

- b) Differentiate between Bulk, Solution, Suspension and Emulsion Polymerization. [6]

SECTION - II

Q7) Describe with neat process sheet the reactor systems used for HDPE, Nylon 6 polymers. [18]

OR

- Q8) a)** Discuss with neat diagram the German Tower process for polymerization of styrene. [9]
- b) Discuss the process flow sheet for the manufacture of PVC by suspension polymerization. [9]

- Q9) a)** Derive the suitable model to understand the step growth kinetics at higher conversion. [8]
- b) In step growth polymerization distribution function in terms of degree of polymerization is given by $W_{DP} = DP (\ln p)^2 p^{DP}$ find number average and weight average degree of polymerization. Where, DP = Degree of polymerization and p = percentage conversion. [8]

OR

- Q10)a)** Discuss the role of mass transfer in step growth polymerization. Explain how to control of molecular weight in Step growth polymerization. [10]
- b) Write a note on types of metallocene Catalyst. [6]

Q11) Write a short note on Reactor Selection for carrying out polymerization reaction and Role of control engineering in Polymerization reactor. [16]

OR

- Q12)a)** Write a note on Safety of Polymerization reactors. [8]
- b) Explain with neat sketch process variable used in polymerization process. [8]

