## B.E. CHEMICAL ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2024

## HIGH POLYMER TECHNOLOGY

FM-100

Time-3hrs

| Question | CO   | Question  | Marks       |
|----------|------|---|-------------|
| No 1     | No.  | (i) How molecular weight distribution is related with functionality for                                       | 4+4+6+6=20  |
|          |      | bi/polyfunctional system?   | 1111010 20  |
|          |      |   |             |
|          |      | (ii) Show the branch point formation considering the reaction between diamine and epoxy.                      |             |
|          |      | (iii) Derive the kinetic relations of self-catalysed condensation reaction. Write                             | •           |
|          |      | down the reasons behind deviation from linearity in degree of polymerization vs                               |             |
|          |      | time curve.   |             |
|          |      | (iv) Write down the structure of the repeat unit of the following:  |             |
|          |      | $CH_2 = CH - CN + CH_2 = CH$ $H_2N - C - NH_2 + HO - CH_2 - CH_2OH$ $CH_2OH$ $CH_2OH$                         |             |
| į        |      | HOOC — COOH and HO — (CH <sub>2</sub> ) <sub>10</sub> — OH  |             |
| 2        | CO-2 | (i) a. Polyester fibers can be produced from $\omega$ = hydroxycaproic acid.                                  | 10+10+10=30 |
|          |      | $nHO - (CH2)5 - C - OH \xrightarrow{\Delta} \begin{bmatrix} O \\ -(CH2)5 - C - O - \end{bmatrix}_{n} + 2nH2O$ | * .<br>* )  |
|          |      | If the initial 100 moles of the hydroxyl acid are reduced to 5 moles after 12 hours                           |             |
|          |      | reaction time, calculate:   |             |
|          |      | i. The number average molecular weight M <sub>n</sub>   |             |
|          |      | ii. The weight average molecular weight M <sub>w</sub>  |             |
|          |      | b. As a result of extraneous reactions of the hydroxyl groups, a 3% excess of the                             |             |
|          |      | carboxylic acid is present in the reaction mixture. Calculate the number-average                              |             |
|          |      | molecular weight for the same extent of reaction in a.  | •           |
|          |      | c. If 4 mol% of monoacid is present as impurity. What will be the maximum degree                              |             |
|          |      | of polymerization?  |             |
|          |      | (ii) Write short notes on: (a) Zeigler Natta polymerization (c) Retardation effect                            |             |
|          |      | (iii) From the data given below for the emulsion polymerization styrene in water at 60°C:                     |             |
|          | , .  | a. Calculate the rate of polymerization. (4)  |             |
|          |      |   |             |

| c. Estimate the number of polymer chains in each. (4)  Data:  K <sub>P</sub> = 200 l mol <sup>-1</sup> s <sup>-1</sup> R <sub>I</sub> = 5*10 <sup>12</sup> radicals cc <sup>-1</sup> s <sup>-1</sup> N = 10 <sup>13</sup> particles scc <sup>-1</sup> [M] = 10 M  Latex particle size = 0.20 µm  Particle density = 1.5 g/cc  (ii) Estimate the feed and copolymer compositions for the azeotropic copolymerization of 1,3 butadiene and vinyl chloride at 50°C.    Monomer 1   Monomer 2   r <sub>1</sub>   r <sub>2</sub>   T (°C)   Acrytonitrile   1.3 Butadiene   0.02   0.30   40     Methyl methacrylate   0.15   1.22   80     Styrene   0.04   0.40   60     Vinyl acleate   4.2   0.05   50     Vinyl chloride   2.7   0.40   60     Vinyl chloride   3.8   0.35   50     Methyl methacrylate   0.75   0.25   90     Styrene   0.46   0.52   60     Vinyl chloride   3.8   0.35   50     Methyl methacrylate   57   0.25   90     Styrene   0.46   0.52   60     Vinyl chloride   3.8   0.35   50     Methyl methacrylate   57   0.01   60     Vinyl chloride   10   0.1   68     Vinyl chloride   10   0.1   68     Vinyl chloride   17   0.02   60     Vinyl cetate   50   0.01   60     Vinyl chloride   17   0.02   60     Vinyl chloride   17   0.02   60     Vinyl chloride   17   0.02   60     Vinyl chloride   18   0.01   60     Vinyl chloride   17   0.02   60     Vinyl chloride   17   0.02   60     Vinyl chloride   18   0.01   60     Vinyl chloride   19   0.1   68     Vinyl chloride   10   0.1   68     Vinyl chloride   10   0.1   68     Vinyl chloride   10   0.1   60     Vinyl chl   |   |      | b. Show that the number average                               | e degree of polyme | erizatio       | n. (4)         |       |            |     |  |
|---|---|------|---|--------------------|----------------|----------------|-------|------------|-----|--|
| $K_p = 200 \ 1  \text{mol}^{-1} \ s^{-1}$ $R_i = 5^* 10^{12} \ \text{radicals} \ \text{ce}^{-1} \ \text{s}^{-1}$ $N = 10^{13} \ \text{particles} \ \text{ce}^{-1}$ $N = 10^{13} \ \text{particles} \ \text{ce}^{-1}$ $ M  = 10 \ M$ $Latex \ \text{particles} \ \text{cise} = 0.20  \text{µm}$ $\text{Particle density} = 1.5 \ \text{g/cc}$ $3  \text{CO-3}  \text{(i) Discuss} \ \text{glass-rubber transition behaviour of polymer.}$ $\text{(ii) Estimate the feed and copolymer compositions for the azeotropic copolymerization of 1,3 butadiene and vinyl chloride at 50^{\circ}\text{C}.  \frac{\text{Monomer 1}}{\text{Acrylonitrile}} \ \frac{\text{Monomer 2}}{1.3 \text{butadiene}} \ \frac{\text{r.}}{1.2} \ \frac{\text{r.}}{1.2} \ \frac{\text{T.}^{\circ}\text{CO}}{1.2} \ \frac{\text{R.}}{1.2} \ \frac{\text{R.}}{1.2}$ |   |      | c. Estimate the number of polym                               |                    |                |                |       |            |     |  |
| $R_i = 5*10^{12} \text{ radicals cc}^{-1} \text{ s}^{-1} \\ N = 10^{13} \text{ particles cc}^{-1} \\ [M] = 10 \text{ M} \\ \text{Latex particle size} = 0.20 \mu m \\ \text{Particle density} = 1.5 \text{ g/cc} \\ \hline 3 & \text{CO-3} & \text{(i) Discuss glass-rubber transition behaviour of polymer.} \\ \text{(ii) Estimate the feed and copolymer compositions for the azeotropic copolymerization of 1,3 butadiene and vinyl chloride at 50^{\circ}\text{C}.} $  |   |      | Data:   |                    |                |                |       |            |     |  |
| N = 1013 particles cc <sup>-1</sup>   [M] = 10 M   Latex particle size = 0.20 jum   Particle density = 1.5 g/cc   |   |      | $K_p = 200 \text{ 1 mol}^{-1} \text{ s}^{-1}$                 |                    |                |                |       |            |     |  |
| IM] = 10 M   Latex particle size = 0.20µm   Particle density = 1.5 g/cc    3  |   |      | $R_i = 5*10^{12} \text{ radicals } cc^{-1} \text{ s}^{-1}$    |                    |                |                |       |            |     |  |
| Latex particle size = $0.20 \mu m$ Particle density = $1.5 \text{ g/cc}$ 3 CO-3 (i) Discuss glass-rubber transition behaviour of polymer.  (ii) Estimate the feed and copolymer compositions for the azeotropic copolymerization of $1.3$ butadiene and vinyl chloride at $50^{\circ}\text{C}$ .    Monomer 1   Monomer 2   r_1   r_2   T (^{\circ}\text{C})  |   |      |   |                    |                |                |       |            |     |  |
| Particle density = 1.5 g/cc   |   |      | · ·   |                    |                |                |       |            |     |  |
| CO-3 (i) Discuss glass-rubber transition behaviour of polymer.  (ii) Estimate the feed and copolymer compositions for the azeotropic copolymerization of 1,3 butadiene and vinyl chloride at 50°C.    Monomer 1   |   |      | Latex particle size = 0.20μm                                  |                    |                |                |       |            |     |  |
| (ii) Estimate the feed and copolymer compositions for the azeotropic copolymerization of 1,3 butadiene and vinyl chloride at 50°C.    Monomer 1   |   |      |   |                    |                |                |       |            |     |  |
| copolymerization of 1,3 butadiene and vinyl chloride at $50^{\circ}$ C.    Monomer 1   Monomer 2   r_1   r_2   T (°C)     Acrylomitrile   1,3-Butadiene   0.02   0.30   40     Methyl methacrylate   0.15   1.22   80     Styrene   0.04   0.40   60     Vinyl acetate   4.2   0.05   50     Vinyl chloride   2.7   0.04   60     Vinyl chloride   2.7   0.04   60     Vinyl chloride   3.8   0.035   50     Methyl methacrylate   5.9   5.9     Styrene   0.46   0.52   60     Vinyl chloride   10   0.1   68     Styrene   Vinyl acetate   20   0.015   60     Vinyl chloride   17   0.02   60     Vinyl chloride   17   0.02   60     (iii) 0.25 gm of polystyrene (PS) sample is dissolved in 200 ml of butanone. Flow time of are measured employing ubbelhode capillary viscometer. Determine the molecular weight of PS.   Given: Flow time of butanone = 130 sec and that of PS solution is 160 sec. K = 40*10-3 and a = 0.6     (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C     with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.   Data:   f = 1  | 3 | CO-3 | (i) Discuss glass-rubber transition                           | 5+5+5+10=25        |                |                |       |            |     |  |
|   |   |      | (ii) Estimate the feed and                                    | copolymer comp     | positio        | ns for         | the   | azeotropic |     |  |
| Acrylomitrile  1,3-Butadiene Methyl methacrylate 0.15 Styrene 0.04 0.04 0.05 Styrene 0.04 0.05 0.05 0.05 0.05 0.05 0.05 0.05  |   | ,    | copolymerization of 1,3 butadie                               | ne and vinyl chlor | ide at 5       | 0°С.           |       |            |     |  |
| Methyl methacrylate 0.15 1.22 80 Styrene 0.04 0.40 60 Vinyl actestae 4.2 0.05 50 Vinyl chloride 2.7 0.04 60  1,3-Butadiene Methyl methacrylate 0.75 0.25 90 Styrene 1.35 0.58 50 Vinyl chloride 8.8 0.035 50 Methyl methacrylate 0.76 0.25 60 Vinyl chloride 8.8 0.035 50 Methyl methacrylate 0.76 0.25 60 Vinyl chloride 10 0.15 68 Styrene 0.46 0.52 60 Vinyl actestae 20 0.015 60 Vinyl chloride 10 0.1 68 Styrene Vinyl actestae 55 0.01 60 Vinyl chloride 17 0.02 60  (iii) 0.25 gm of polystyrene (PS) sample is dissolved in 200 ml of butanone. Flow time of are measured employing ubbelhode capillary viscometer. Determine the molecular weight of PS.  Given: Flow time of butanone = 130 sec and that of PS solution is 160 sec. K = 40*10 <sup>3</sup> and a = 0.6  (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data:  f = 1  K <sub>p</sub> <sup>2</sup> /K <sub>1</sub> = 2 *10 <sup>-3</sup> /mol-s  [1] = 6.0 *10 <sup>-3</sup> mol/l  K <sub>d</sub> = 2*10 <sup>-4</sup> s <sup>-1</sup> 4 CO-4 Write short note on: Extrusion, Dipping  Or Discuss the different steps associated with injection molding process?   |   |      | Monomer 1   | Monomer 2          | r <sub>1</sub> | r <sub>2</sub> | T (°C | )          |     |  |
| Styrene 0.04 0.40 60 Vinyl actate 4.2 0.05 50 Vinyl chloride 2.7 0.04 60  1.3-Butadiene Methyl methacrylate 0.75 0.25 90 Styrene 1.35 0.58 50 Vinyl chloride 8.8 0.035 50 Vinyl chloride 8.8 0.035 50 Vinyl chloride 1.0 0.1 60 Vinyl chloride 1.7 0.02 60 Vinyl chloride 1.  |   |      |   | ,                  |                |                |       |            |     |  |
| Vinyl acetate 4.2 0.05 50 Vinyl chloride 2.7 0.04 60  1,3-Butadiene Methyl methacrylate 0.75 0.25 90 Styrene 1.35 0.58 50 Vinyl chloride 8.8 0.035 50  Methyl methacrylate Styrene 0.46 0.52 60 Vinyl acetate 20 0.015 60 Vinyl acetate 55 0.01 60 Vinyl chloride 17 0.02 60  (iii) 0.25 gm of polystyrene (PS) sample is dissolved in 200 ml of butanone. Flow time of are measured employing ubbelhode capillary viscometer. Determine the molecular weight of PS.  Given: Flow time of butanone = 130 sec and that of PS solution is 160 sec. K = 40*10 <sup>-3</sup> and a = 0.6  (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data:  f = 1  K <sub>p</sub> <sup>2</sup> /K <sub>1</sub> = 2 *10 <sup>-3</sup> /mol-s  [I] = 6.0 *10 <sup>-3</sup> mol/l  K <sub>d</sub> = 2*10 <sup>-6</sup> s <sup>-1</sup> 4 CO-4 Write short note on: Extrusion, Dipping  Or Discuss the different steps associated with injection molding process?   |   |      |   |                    |                |                |       |            |     |  |
| 1,3-Butadiene    Methyl methacrylate   0.75   0.25   90     Styrene   1.35   0.58   50     Winyl chloride   8.8   0.035   50     Methyl methacrylate   Styrene   0.46   0.52   60     Vinyl acetate   20   0.015   60     Vinyl acetate   20   0.015   60     Vinyl acetate   55   0.01   60     Vinyl acetate   55   0.01   60     Vinyl chloride   17   0.02   60     (iii) 0.25 gm of polystyrene (PS) sample is dissolved in 200 ml of butanone. Flow time of are measured employing ubbelhode capillary viscometer. Determine the molecular weight of PS.   Given: Flow time of butanone = 130 sec and that of PS solution is 160 sec. K = 40*10 <sup>-3</sup> and a = 0.6     (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.   Data:   f = 1   K <sub>P</sub> <sup>2</sup> /K <sub>1</sub> = 2 *10 <sup>-3</sup> l/mol-s     [I] = 6.0 *10 <sup>-3</sup> mol/I   K <sub>d</sub> = 2*10 <sup>-6</sup> s <sup>-1</sup>     4   |   |      | V   | inyl acetate       |                | 0.05           |       |            |     |  |
| Styrene  Methyl methacrylate  Methyl methacrylate  Styrene  Vinyl chloride  Styrene  Vinyl acetate  Vinyl aceta  |   |      |   |                    |                |                |       |            |     |  |
| Methyl methacrylate Styrene 0.46 0.52 60 Vinyl acetate 20 0.015 60 Vinyl chloride 10 0.1 68 Styrene Vinyl acetate 55 0.01 60 Vinyl chloride 17 0.02 60  (iii) 0.25 gm of polystyrene (PS) sample is dissolved in 200 ml of butanone. Flow time of are measured employing ubbelhode capillary viscometer. Determine the molecular weight of PS.  Given: Flow time of butanone = 130 sec and that of PS solution is 160 sec. K = 40*10*3 and a = 0.6  (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data:  f = 1  K <sub>p</sub> <sup>2</sup> /K <sub>t</sub> = 2 *10*31/mol-s  [I] = 6.0 *10*3 mol/1  K <sub>d</sub> = 2*10*6 s*1  4 CO-4 Write short note on: Extrusion, Dipping  Or  Discuss the different steps associated with injection molding process?   |   |      |   |                    | 1.35           |                |       |            |     |  |
| Vinyl acetate 20 0.015 60 Vinyl chloride 10 0.1 68 Styrene Vinyl chloride 17 0.02 60  (iii) 0.25 gm of polystyrene (PS) sample is dissolved in 200 ml of butanone. Flow time of are measured employing ubbelhode capillary viscometer. Determine the molecular weight of PS.  Given: Flow time of butanone = 130 sec and that of PS solution is 160 sec. K = 40*10 <sup>-3</sup> and a = 0.6  (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data:  f = 1  K <sub>p</sub> <sup>2</sup> /K <sub>t</sub> = 2 *10 <sup>-3</sup> l/mol-s  [I] = 6.0 *10 <sup>-3</sup> mol/l  K <sub>d</sub> = 2*10 <sup>-6</sup> s <sup>-1</sup> 4 CO-4 Write short note on: Extrusion, Dipping  Or  Discuss the different steps associated with injection molding process?   |   |      |   | •                  |                |                |       |            |     |  |
| Styrene  Vinyl chloride 10 0.1 68 Vinyl acetate 55 0.01 60  (iii) 0.25 gm of polystyrene (PS) sample is dissolved in 200 ml of butanone. Flow time of are measured employing ubbelhode capillary viscometer. Determine the molecular weight of PS.  Given: Flow time of butanone = 130 sec and that of PS solution is 160 sec. K = 40*10 <sup>-3</sup> and a = 0.6 (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data: f = 1  K <sub>p</sub> <sup>2</sup> /K <sub>t</sub> = 2*10 <sup>-3</sup> l/mol-s [I] = 6.0*10 <sup>-3</sup> mol/l  K <sub>d</sub> = 2*10 <sup>-6</sup> s <sup>-1</sup> 4 CO-4 Write short note on: Extrusion, Dipping  Or Discuss the different steps associated with injection molding process?   |   |      |   |                    |                |                |       |            |     |  |
| Vinyl chloride 17 0.02 60  (iii) 0.25 gm of polystyrene (PS) sample is dissolved in 200 ml of butanone. Flow time of are measured employing ubbelhode capillary viscometer. Determine the molecular weight of PS.  Given: Flow time of butanone = 130 sec and that of PS solution is 160 sec. K = 40*10 <sup>-3</sup> and a = 0.6  (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data:  f = 1  K <sub>p</sub> <sup>2</sup> /K <sub>1</sub> = 2 *10 <sup>-3</sup> l/mol-s  [I] = 6.0 *10 <sup>-3</sup> mol/l  K <sub>d</sub> = 2*10 <sup>-6</sup> s <sup>-1</sup> 4 CO-4 Write short note on: Extrusion, Dipping  Or  Discuss the different steps associated with injection molding process?  |   |      | V   | inyl chloride      | 10             | 0.1            | 68    |            |     |  |
| time of are measured employing ubbelhode capillary viscometer. Determine the molecular weight of PS.  Given: Flow time of butanone = 130 sec and that of PS solution is 160 sec. K = 40*10 <sup>-3</sup> and a = 0.6  (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data:  f = 1  K <sub>p</sub> <sup>2</sup> /K <sub>t</sub> = 2 *10 <sup>-3</sup> l/mol-s  [I] = 6.0 *10 <sup>-3</sup> mol/l  K <sub>d</sub> = 2*10 <sup>-6</sup> s <sup>-1</sup> 4 CO-4 Write short note on: Extrusion, Dipping  Or  Discuss the different steps associated with injection molding process?   |   |      |   |                    |                |                |       |            |     |  |
| molecular weight of PS. Given: Flow time of butanone = 130 sec and that of PS solution is 160 sec. K = 40*10 <sup>-3</sup> and a = 0.6 (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data:  f = 1  K <sub>p</sub> <sup>2</sup> /K <sub>t</sub> = 2 *10 <sup>-3</sup> l/mol-s  [I] = 6.0 *10 <sup>-3</sup> mol/l  K <sub>d</sub> = 2*10 <sup>-6</sup> s <sup>-1</sup> 4 CO-4 Write short note on: Extrusion, Dipping  Or  Discuss the different steps associated with injection molding process?  5 CO-5 Write the manufacturing method of Poly ethylene with PFD.  |   |      | (iii) 0.25 gm of polystyrene (PS                              |                    |                |                |       |            |     |  |
| Given: Flow time of butanone = 130 sec and that of PS solution is 160 sec. K = 40*10 <sup>-3</sup> and a = 0.6  (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data:  f = 1  K <sub>p</sub> <sup>2</sup> /K <sub>t</sub> = 2 *10 <sup>-3</sup> l/mol-s  [I] = 6.0 *10 <sup>-3</sup> mol/l  K <sub>d</sub> = 2*10 <sup>-6</sup> s <sup>-1</sup> 4 CO-4 Write short note on: Extrusion, Dipping  Or  Discuss the different steps associated with injection molding process?  5 CO-5 Write the manufacturing method of Poly ethylene with PFD.   |   |      | time of are measured employing                                | 1.                 |                |                |       |            |     |  |
| 40*10 <sup>-3</sup> and a = 0.6  (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data:  f = 1  K <sub>p</sub> <sup>2</sup> /K <sub>t</sub> = 2 *10 <sup>-3</sup> l/mol-s  [I] = 6.0 *10 <sup>-3</sup> mol/l  K <sub>d</sub> = 2*10 <sup>-6</sup> s <sup>-1</sup> 4 CO-4 Write short note on: Extrusion, Dipping  Or  Discuss the different steps associated with injection molding process?  5 CO-5 Write the manufacturing method of Poly ethylene with PFD.  |   |      |   |                    |                |                |       |            |     |  |
| (iv) Calculate the time required for 30 % polymerization of pure styrene at 60°C with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data:  f = 1  K <sub>p</sub> <sup>2</sup> /K <sub>t</sub> = 2 *10 <sup>-3</sup> l/mol-s  [I] = 6.0 *10 <sup>-3</sup> mol/l  K <sub>d</sub> = 2*10 <sup>-6</sup> s <sup>-1</sup> 4 CO-4 Write short note on: Extrusion, Dipping  Or  Discuss the different steps associated with injection molding process?  5 CO-5 Write the manufacturing method of Poly ethylene with PFD.   |   |      | Given: Flow time of butanone                                  |                    |                |                |       |            |     |  |
| with benzoyl peroxide as the initiator in a batch reactor. Assume that the initiator concentration remains (a) constant and (b) first order decay.  Data: $f = 1$ $K_p^2/K_t = 2 * 10^{-3} \text{l/mol-s}$ $[I] = 6.0 * 10^{-3} \text{ mol/l}$ $K_d = 2 * 10^{-6} \text{ s}^{-1}$ 4 CO-4 Write short note on: Extrusion, Dipping Or Discuss the different steps associated with injection molding process?  5 CO-5 Write the manufacturing method of Poly ethylene with PFD.  |   |      | $40*10^{-3}$ and $a = 0.6$                                    |                    |                |                |       |            |     |  |
| concentration remains (a) constant and (b) first order decay.  Data: $f = 1$ $K_p^2/K_t = 2 *10^{-3} \text{l/mol-s}$ $[I] = 6.0 *10^{-3} \text{ mol/l}$ $K_d = 2*10^{-6} \text{ s}^{-1}$ 4 CO-4 Write short note on: Extrusion, Dipping Or Discuss the different steps associated with injection molding process?  5 CO-5 Write the manufacturing method of Poly ethylene with PFD.   |   |      | (iv) Calculate the time required                              |                    |                |                |       |            |     |  |
| Data: $f = 1$ $K_{p}^{2}/K_{t} = 2 * 10^{-3} \text{l/mol-s}$ $[I] = 6.0 * 10^{-3} \text{ mol/l}$ $K_{d} = 2 * 10^{-6} \text{ s}^{-1}$ 4 CO-4 Write short note on: Extrusion, Dipping Or Discuss the different steps associated with injection molding process?  5 CO-5 Write the manufacturing method of Poly ethylene with PFD.  |   |      | with benzoyl peroxide as the in                               |                    |                |                |       |            |     |  |
| $f = 1$ $K_p^2/K_t = 2 * 10^{-3} \text{l/mol-s}$ $[I] = 6.0 * 10^{-3} \text{ mol/l}$ $K_d = 2 * 10^{-6} \text{ s}^{-1}$ $4  \text{CO-4}  \text{Write short note on: Extrusion, Dipping}$ $Or$ $Discuss the different steps associated with injection molding process?}$ $5  \text{CO-5}  \text{Write the manufacturing method of Poly ethylene with PFD.}$  |   |      | concentration remains (a) constant and (b) first order decay. |                    |                |                |       |            |     |  |
| $K_p^2/K_t = 2*10^{-3} \text{l/mol-s}$ $[I] = 6.0*10^{-3} \text{ mol/l}$ $K_d = 2*10^{-6} \text{ s}^{-1}$ $4  \text{CO-4}  \text{Write short note on: Extrusion, Dipping} \qquad \qquad 10$ $Or$ $Discuss the different steps associated with injection molding process?} 5  \text{CO-5}  \text{Write the manufacturing method of Poly ethylene with PFD.} \qquad 15$   |   |      | Data:   |                    |                |                |       |            |     |  |
| $[I] = 6.0 * 10^{-3} \text{ mol/l}$ $K_d = 2* 10^{-6} \text{ s}^{-1}$ $4  \text{CO-4}  \text{Write short note on: Extrusion, Dipping} \qquad \qquad 10$ $Or$ $Discuss the different steps associated with injection molding process?}$ $5  \text{CO-5}  \text{Write the manufacturing method of Poly ethylene with PFD.}$ $15$  |   |      | f=1   |                    |                |                |       |            |     |  |
| K <sub>d</sub> = 2*10 <sup>-6</sup> s <sup>-1</sup> 4 CO-4 Write short note on: Extrusion, Dipping Or Discuss the different steps associated with injection molding process?  5 CO-5 Write the manufacturing method of Poly ethylene with PFD.  |   | 1    | $K_p^2/K_t = 2 * 10^{-3} l/mol-s$                             |                    |                |                |       |            | •   |  |
| 4 CO-4 Write short note on: Extrusion, Dipping Or Discuss the different steps associated with injection molding process?  5 CO-5 Write the manufacturing method of Poly ethylene with PFD.  15  |   |      | $[I] = 6.0 * 10^{-3} \text{ mol/l}$                           | V                  |                |                |       |            |     |  |
| Or Discuss the different steps associated with injection molding process?  5 CO-5 Write the manufacturing method of Poly ethylene with PFD.   |   |      | $K_d = 2*10^{-6} \text{ s}^{-1}$                              |                    | •              |                |       |            |     |  |
| Discuss the different steps associated with injection molding process?  5 CO-5 Write the manufacturing method of Poly ethylene with PFD.  15  | 4 | CO-4 | Write short note on: Extrusion,                               | 10                 |                |                |       |            |     |  |
| 5 CO-5 Write the manufacturing method of Poly ethylene with PFD.  |   |      |   |                    |                |                |       |            |     |  |
| Write the manufacturing method of Foly emylene with Fig.  |   |      |   |                    |                |                |       |            |     |  |
| Total 100   | 5 | CO-5 | _   |                    | with F         | FD.            |       |            |     |  |
|   |   |      | Tota  | al                 |                |                |       |            | 100 |  |