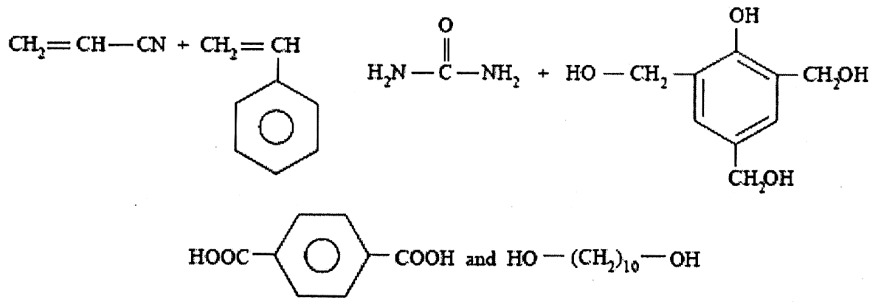
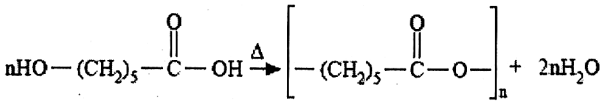
B.E. CHEMICAL ENGINEERING FOURTH YEAR
SECOND SEMESTER EXAM 2024

HIGH POLYMER TECHNOLOGY

FM-100 Time-3hrs

Question No	CO No.	Question	Marks
1	CO-1	(i) How molecular weight distribution is related with functionality for bi/polyfunctional system? (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: 	4+4+6+6=20
2	CO-2	(i) a. Polyester fibers can be produced from ω = hydroxycaproic acid.  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_n ii. The weight average molecular weight M_w 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)	10+10+10=30

<table>
<tr><td></td><td></td><td>b. Show that the number average degree of polymerization. (4)
c. Estimate the number of polymer chains in each. (4)
Data:
$K_p = 200$ l mol^{-1} s^{-1}
$R_i = 5*10^{12}$ radicals cc^{-1} s^{-1}
$N = 10^{13}$ particles cc^{-1}
[M] = 10 M
Latex particle size = 0.20μm
Particle density = 1.5 g/cc</td><td></td></tr>
<tr><td>3</td><td>CO-3</td><td>(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.
<table>
<tr><th>Monomer 1</th><th>Monomer 2</th><th>r_1</th><th>r_2</th><th>T (°C)</th></tr>
<tr><td>Acrylonitrile</td><td>1,3-Butadiene</td><td>0.02</td><td>0.30</td><td>40</td></tr>
<tr><td></td><td>Methyl methacrylate</td><td>0.15</td><td>1.22</td><td>80</td></tr>
<tr><td></td><td>Styrene</td><td>0.04</td><td>0.40</td><td>60</td></tr>
<tr><td></td><td>Vinyl acetate</td><td>4.2</td><td>0.05</td><td>50</td></tr>
<tr><td></td><td>Vinyl chloride</td><td>2.7</td><td>0.04</td><td>60</td></tr>
<tr><td>1,3-Butadiene</td><td>Methyl methacrylate</td><td>0.75</td><td>0.25</td><td>90</td></tr>
<tr><td></td><td>Styrene</td><td>1.35</td><td>0.58</td><td>50</td></tr>
<tr><td></td><td>Vinyl chloride</td><td>8.8</td><td>0.035</td><td>50</td></tr>
<tr><td>Methyl methacrylate</td><td>Styrene</td><td>0.46</td><td>0.52</td><td>60</td></tr>
<tr><td></td><td>Vinyl acetate</td><td>20</td><td>0.015</td><td>60</td></tr>
<tr><td></td><td>Vinyl chloride</td><td>10</td><td>0.1</td><td>68</td></tr>
<tr><td>Styrene</td><td>Vinyl acetate</td><td>55</td><td>0.01</td><td>60</td></tr>
<tr><td></td><td>Vinyl chloride</td><td>17</td><td>0.02</td><td>60</td></tr>
</table>
(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:
$f = 1$
$K_p^2/K_t = 2*10^{-3}$ l/mol-s
$[I] = 6.0*10^{-3}$ mol/l
$K_d = 2*10^{-6}$ s^{-1}</td><td>5+5+5+10=25</td></tr>
<tr><td>4</td><td>CO-4</td><td>Write short note on: Extrusion, Dipping
Or
Discuss the different steps associated with injection molding process?</td><td>10</td></tr>
<tr><td>5</td><td>CO-5</td><td>Write the manufacturing method of Poly ethylene with PFD.</td><td>15</td></tr>
<tr><td colspan="3">Total</td><td>100</td></tr>
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