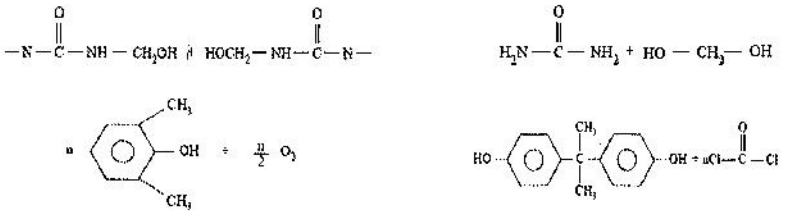
B.E. CHEMICAL ENGINEERING FOURTH YEAR SECOND SEMESTER EXAMINATION-2018

Subject: HIGH POLYMER TECHNOLOGY

Time: Three hours | Full Marks: 100

Different parts of the same question should be answered together.

Q1 (8+6+3+8)	(a) Distinguish the repeat Units from the following.  (b) Write down the mechanism (show all steps and consider head to head configuration) of addition polymerization considering styrene as monomer. (c) Write down the typical recipe of Emulsion polymerization **Or** Differentiate Bulk polymerization from Suspension Polymerization (d) Write short note on (any two): (i) Tacticity (ii) Inhibition (iii) Gel point
Q2 (8+10+4+3)	(a) The following data were obtained in a determination of the average molecular weight of a polymer. **Molecular Weight** / **Weight (g)** 60,000 / 1.0 40,000 / 2.0 20,000 / 5.0 10,000 / 2.5 Compute (i) the number average, (ii) the weight average-molecular weight, and (iii) polydispersity of the polymer. (b) A polymer chemist prepared nylon from an amino acid [mol. wt = 200]. Due to improper purification of the reactant, side reactions occurred leading to a 5% stoichiometric imbalance (i.e., 5% excess of one of the functional groups). Calculate: (i). The number-average molecular weight if conversion was 98%. (ii). The number-average molecular weight for the maximum degree of polymerization (p=1) **Or** Consider the isothermal solution polymerization of styrene at 60°C in the following formulation: 100 g styrene; 400 g benzene; 0.5 g benzoyl peroxide Assume that the initiator is 100% efficient and has a half-life of 44 h. At 60°C, k_p = 145 l/mol-s, k_t = 0.130 l/mol-s. All ingredients have unit density. (i). Derive the rate expression for this polymerization reaction. (ii). Calculate the rate of propagation at 50% conversion. (c) (i) Methyl methacrylate and vinyl chloride form an ideal copolymerization at 68°C. What is the composition of this copolymer for a feed composition f_1 = 0.75 and r_2 = 0.1? (ii) What are the conditions of Aezotropicity.
Q3 (8+5+4+8)	(a) You have been asked to dissolve 0.25 gm of polymer solution in 200 ml of solvent and then find out the molecular weight of the polymer. Given: Flow time $_{\text{Polymer soln}}$= 150 sec; Flow time $_{\text{solvent}}$= 100 sec; Mark-Howink constant = $40*10^{-3}$ and a = 0.6

	(b) (i) Explain different regions of glass rubber transition of a viscoelastic polymer **Or** Describe one method of measuring glass transition temperature of a viscoelastic material. (ii) State the effect of Filler and Temperature on viscoelasticity. (c) 21.3 g sample of poly(hexamethylene adipamide) [M_0 = 113] is found to contain 2.5×10^{-3} mol of carboxyl groups by both titration with base and infrared spectroscopy. From these data calculate: (i). The number-average molecular weight; (ii).The extent of reaction. **Or** A steady state free radical polymerization is being controlled such that the rate of polymerization is constant at $2*10^{-3}$ gm of monomer/ml-min. Let the initiator concentration be $6*10^{-6}$ mol/l. (i) What would be the value of free radical generation and value of X_n? (ii) What % of initiator concentration remains after 3 hrs?
Q4 (2+3+5+5+10)	(a) (i) What are the different types of screw zones in an extruder and (ii) state the necessity of introducing different types of screw zones. (iii) Show the steps of Calendaring **Or** Injection molding schematically. (b) State the mechanism of Stretching **Or** Electro-spinning during polymer membrane fabrication? (c) Describe the Technology involved in (show the process flow sheet): Low pressure process of Poly ethylene manufacturing **Or** Nylon manufacture