UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: B.Tech(CE+RP) **Semester – V**
Subject (Course): Polymer Science and Engineering **Max. Marks : 100**
Course Code : CHEG 384 **Duration : 3 Hrs**
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SECTION A **5 X 4 = 20 Marks**

1. Calculate the weight fraction of monomer, when linear step growth polymerization of Nylon-6,6 is carried out to 80% conversion starting with equimolar mixture of hexamethylene diamine and adipic acid.
2. What is living polymerization and give an example. Give any one of its advantage and disadvantage.
3. What are the values of reactivity ratio at which co-polymerization yield alternating, bulk and random co-polymers?
4. 500 g of polystyrene is comprised of 200 g of molecular weight 50,000 g/mole and the rest has the molecular weight of 75,000 g/mole. Calculate the polydispersity index of polystyrene.
5. What kinds of polymers undergo hydrolysis? Give an example each for hydrolysis of polymer involving main chain and side group.

SECTION B **5 X 8 = 40 Marks**

6. (a) Show that step growth polymerization of monomers of type A-B and R-A_3 can only result in branched but not cross-linked polymer.
   (b) What is gel point? How is it experimentally determined?
7. (a) Through the mechanism of Reversible Addition Fragmentation Termination(RAFT) polymerization, demonstrate it can yield polymers of almost monodispersity.
   . (b) Methacrylate is polymerized by anionic addition polymerization using n-alkyl lithium as initiator which ionizes to 100%. The initial concentration of monomer and initiator are 1.4 X 10^{-2} and 1.2 X 10^{-6} mol/L respectively. If the polymerization proceeds to 85% conversion in 30 minutes, calculate the propagation rate constant,

   (Or)

   (a) Derive the rate expression for the co-ordination polymerization following monometallic mechanism
   (b) What are the different ways of propagation of polymerization of isoprene and their corresponding polymeric products?
8. (a) Calculate the mole fraction of the butadiene in the Styrene-Butadiene Rubber, when the starting reaction mixture contain butadiene of mole fraction 0.6. The reactivity ratio of styrene and butadiene are 0.9 and 2.6 respectively.
   (b) Differentiate the following with suitable examples.

(i) Homo chain and Hetro chain polymer (ii) Homo and co-polymer

9. With the help of diagram, explain the determination of molecular weight distribution by gel permeation chromatography.
10. List out the various means of degradation of polymers and explain any two of them in detail.

SECTION C **2 X 20 = 40 Marks**

11. (a) Explain the mechanism ring opening polymerization in detail and how does ring opening polymerization differ from addition polymerization. (6)

(b) What are stereoregular polymers? Give the structure of each. What is their importance? Name the method by which they are produced. (4)

(c) Raleigh ratio of polypropylene in acetone was determined as a function of concentration by low-angle laser light-scattering measurements. If the refractive index of acetone is 1.45, refractive index increment for polypropylene in acetone is 6.247 X 10^{-2} cm^3/g and the wavelength of the light is 650 nm, calculate the weight-average degree of polymerization of polypropylene and second virial coefficient. (10)

C X 10^3 (g/mL)	**R(θ) X 10^5 (cm^{-1})**
0.5	0.24
1.0	0.44
1.5	0.61
2.0	0.79
2.5	0.91

(Or)

(a) If the extent of self-catalyzed, linear polycondensation is 75% after 45 minutes and the initial concentration of both the monomers is 0.6 mol/L, calculate the rate constant of the polycondensation. (5)

(b) Derive the rate expression for cationic addition polymerization. (5)

(c) Solution of PVC in carbon tetrachloride has shown the following viscometric data with Ostwald viscometer. The values of 'a' and 'k' are 0.91 and 4.5 X 10^{-5} dL/g respectively. Calculate the viscosity average molecular weight of PVC. (10)

Concentration (g/dL)	Time (Seconds)
0	65.8
0.5	101.0
1.08	144
2.16	258

12. (a) List out the methods of determination of monomer reactivity ratio and explain any one of them in detail. (6)

(b)List out the different techniques of polymerization and explain any two of them in detail. (8)

(c) Write a summary on addition, substitution and cross linking reactions of polymers with two examples each. (6)