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Fourth Semester B.Tech. Degree Examination, July/August 2022

Textile Polymer Science

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Define the terms monomer, polymer, repeat unit, degree of polymerization and represent above terms taking an example of a polymer. (04 Marks)
- b. Classify the polymers on any 8 basis giving an example in each case and explain the structural origin for thermoplastic and thermoset behavior of polymers. (08 Marks)
- c. Taking an example of monomer explain various steps involved (with chemical reactions) in conversion of monomer into polymer by addition polymerization method. (08 Marks)

OR

- 2 a. State the requirements for monomer to under go polymerization and state why methane and acetic can not be polymerized. (04 Marks)
- b. Explain various requirements of fibre forming polymers and state why water and honey can-not be spun into fibres. (08 Marks)
- c. Give any two examples of polymers produced from condensation polymerization, showing chemical equation for producing them. Compare addition and condensation polymerization methods. (08 Marks)

Module-2

- 3 a. State why solution polymerization technique gives polymer of low molecular weight and bulk polymerization is prone to auto acceleration. (04 Marks)
- b. Derive an expression for kinetic chain length and rate of polymerization in addition polymerization and with the help of illustration and graph show that increase in the $[M]$ increases kinetic length and increase in $[I]$ decreases kinetic chain length. (08 Marks)
- c. Compare various techniques used for producing polymers, giving proper justification for your statements. (08 Marks)

OR

- 4 a. Define the term functionality. Show that tri-bi functional monomers give branched polymer where as bi-bi functional monomers give linear polymer. (04 Marks)
- b. Derive an expression for % conversion (%P) in condensation polymerization and also show that %P of less than 90% gives very low molecular weight or DP. (08 Marks)
- c. Explain the concept of reactivity ratios in co-polymerization. State reactivity ratios to get alternate polymer and azeotropic composition. If ratio of monomers fed ($M_1:M_2$) to the reactor is 60:40, what would be the ratio of $M_1:M_2$ if $r_1 = r_2 = 1$ and $r_1 = r_2 = 0$. (08 Marks)

Module-3

- 5 a. Write a note on flow of polymeric fluid in capillary and spin line. With the help of graph explain pseudoplastic behavior of polymeric fluids. (04 Marks)
- b. With the help of graph and Burger's vector explain time dependent elongation behavior and explain the phenomenon of creep. (08 Marks)
- c. Draw stress strain curve of typical polymer and mark various parameters on the curve giving definition and SI unit for each parameter. (08 Marks)

OR

- 6 a. Write concized note on thermodynamics of polymer solutions. (04 Marks)
- b. A polymer strip of 10cm length 1cm width and 1.0mm thickness was tested for tensile property. Strip broke at a load of 4.0kgs and length of strip at breakage was 12cm. Determine tensile strength of strip in g/cm^2 , N/m^2 and percentage breaking elongation. If the load at elastic limit is 500gms and length of strip at elastic limit is 10.4cm determine initial modulus (in g/cm^2 and N/m^2) and draw approximate stress strain curve. (08 Marks)
- c. Derive an expression for stress relaxation using Maxwell's model and show that this model can not be used for explaining creep phenomenon. (08 Marks)

Module-4

- 7 a. Define term M_w , M_n and MWD and draw N_i V/S M_i curves for three polymers with $MWD_1 > MWD_2 > MWD_3$ and a polymer with $MWD = 1$ (04 Marks)
- b. Explain how viscometry is used to determine M_n and determine M_n using following data: $K = 11.5 \times 10^{-3} \text{ ml/g}$, $a = 0.73$ and $[\eta] = 6.0 \times 10^2 \text{ ml/g}$. (08 Marks)
- c. Explain the importance of determination of molecular weight in production of fibres and plastics and also state how molecular weight influences various properties of polymer (draw graph wherever required). (08 Marks)

OR

- 8 a. A poly dispersed polymer has following molecular weight distribution. Determine M_w , M_n and MWD.

M_i	N_i
8000	100
9000	120
12000	200
13000	110
20000	80

Draw N_i v/s M_i curve for above polymer and determine M_n , M_w and MWD of a mono disperse polymer containing 100 molecules, each of molecular weight 10,000.

- (10 Marks)
- b. With the help of line diagram and graphs explain how M_w , M_n and MWD is found using Gel Permeation Chromatography (GPC). (10 Marks)

Module-5

- 9 a. Define the term T_g . State the factors affecting T_g , give T_g value of any five polymer and determine T_g of polymer blend containing 30% polymer 'A' with T_g of 70°C and 70% of polymer 'B' with T_g of 40°C . (08 Marks)
- b. State and explain chained and random degradation of polymer and state any five agents which cause polymer degradation. (08 Marks)
- c. With the help of graph explain the thermal characterization of polymer using $T \sim A$. (04 Marks)

OR

- 10 a. Draw DSC trace of polymer and explain how various thermal characters are analysed using DSC. (08 Marks)
- b. With the help of chemical reaction explain how polymers get degraded by oxygen and show how antioxidants reduce oxidative degradation. (08 Marks)
- c. Explain the mechanism by which photo stabilizers control UV degradation of polymer. (04 Marks)

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