

L1-/T-II/IPE

Date: 11/09/2025

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-II B.Sc. Engineering Examinations 2023-2024

Sub: CHEM 143 (Chemistry of Materials)

Full Marks: 140

Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION - A

There are **FOUR** questions in this section. Answer to question number 1 is **COMPULSORY**. Also give answer any **TWO** from questions no 2 to 4.

1. (a) Draw the schematic structure of amorphous, semi-crystalline, branched, and cross-linked polymers. Outline the features of physical and chemical cross-linking in polymers. (4) (CO1)
  - (b) Consider two polymer samples, polypropylene (PP) and polyvinylchloride (PVC), which are mostly used at an ambient temperature range of 0-50 °C in our daily life. Illustrate the *specific volume vs. temperature* curves for both the amorphous and semi-crystalline PP and explain the effect of temperature on the physical properties of amorphous polymer with underlying molecular mechanism. Which one of the above two polymers possesses higher  $T_g$  and why? (8) (CO2)
  - (c) Demonstrate corresponding ~~stress-strain~~ <sup>stress</sup> curves to show the difference in mechanical properties of PP operated at -25 °C and 25 °C and PVC operated at 25 °C and 125 °C respectively. (7) (CO3)
  - (d) How does plasticizer affect the  $T_g$  and mechanical properties of PVC? Explain the underlying mechanism. (5) (CO4)
2. (a) Define polydispersity index (PDI). How is PDI calculated? Draw the molecular weight distribution curves for (i) PDI = 1, (ii) PDI > 1, and (iii) PDI >> 1. Comment on the distribution of polymer molecular ~~weights~~ <sup>weights</sup> for all the above cases. (8)
  - (b) What are the differences between emulsion and suspension polymerization? Explain the interfacial polymerization mechanism for the synthesis of polyamide. (8)
  - (c) Explain the effect of temperature on the modulus of an amorphous polymer. Mention the characteristic features of the polymer at various regions with gradual increase <sup>in</sup> temperature above  $T_g$  and  $T_m$ . (7)
3. (a) What is polymer processing? Using an illustration, describe the preparation of PET bottle by blow molding method. (8)

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**CHEM 143/IPE**

**Contd... Q. No. 3**

- (b) What is PVC? How is PVC synthesized? Illustrate a flow chart diagram for manufacturing PVC resin. (8)
- (c) What are Bakelite and Teflon? Mention the properties of Bakelite based on the constituent's molar ratio. What are the uses of Bakelite and Teflon? (7)
4. (a) What is natural rubber? Write the general mechanism for the process of sulfur vulcanization. (7)
- (b) Giving examples, mention the differences between natural and semi-synthetic fibers. Showing illustration, describe the melt spinning process for manufacturing fiber. (8)
- (c) What are styrene butadiene rubber (SBR) and silicone rubber (SR)? Describe their preparation and use. (8)

**SECTION - B**

There are **FOUR** questions in this section. Answer Question 5 any other **TWO** questions.

5. (a) Differentiate between glass and quartz. (4)
- (b) From the aspect of viscosity-temperature profile explain the importance of annealing during the cooling of glass melt. (8)
- (c) What is tempered glass? Describe the principle of tempering of glass? (7)
- (d) During the manufacturer of glass, the melting temperature is extremely high whereas a glass tube at a chemical laboratory could be cut down by simply heating with a burner. How could you explain the phenomenon? (5)
6. (a) Define pigments and extenders. On the basis of refractive index and particle size discuss the properties of pigments and extenders. (8)
- (b) How could alkyd resin be classified according to vegetable oil content? Explain the process of formation of hard protective film while using alkyd resin as binder. (8)
- (c) Describe the function of anti-corrosive pigment enhancer and ultraviolet absorbers as paint additives. (7)

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**CHEM 143/I**

7. (a) What is crevice corrosion. Explain the mechanism of the corrosion occurs if a riveted plate section of metal M is immersed in aerated sea water (pH = 7). (8)
- (b) How could a metal be corroded when exposed to a hydrogen environment? (8)
- (c) Briefly explain the sacrificial anodic protection method for the prevention of corrosion. (7)
8. (a) Describe the mechanism of lubrication phenomenon in cases where the moving surfaces are (i) under high pressure and low speed and (ii) under high pressure and high speed. (10)
- (b) How could the working temperature range of lubricants be determined? (6)
- (c) What is viscosity index? Write short note on viscosity index modifiers. (7)
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