

**III B.Tech. II Semester Regular Examinations, April/May -2005****PLASTICS & POLYMERIC MATERIALS****(Metallurgy & Material Technology)****Time: 3 hours****Max Marks: 80**

**Answer any FIVE Questions**  
**All Questions carry equal marks**

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1. (a) Carbon is the basic building block of a Vast number of molecules and compounds. What other Element would possibly be the basis for a large number of molecules and compounds? Explain your choice.  
(b) What is Depolymerization? Explain the harmful effects of depolymerization.
2. (a) What is a crystal? Compare and contrast the crystalline state in metals and polymers.  
(b) Explain the differences in physical properties of linear and cross linked polymers.
3. What is a stabilizer? Why stabilizers are added to plastics. Give the important characteristics of stabilizers? Name any 3 stabilizers. Give their properties and applications.
4. (a) What are
  - i. Inhibitors
  - ii. Promoters in plastics?  
(b) Give examples for each category.  
(c) Explain the function of each of the additives when added to polymers
5. (a) The density of polyvinyl chloride is approximately  $1.4 \text{ Mg/m}^3$ . Determine the number of vinyl chloride repeat units, hydrogen atoms, chloride atoms and carbon atoms in each unit cell of crystalline PVC.  
(b) A polyethylene sample is reported to have a density of  $0.97 \text{ Mg/m}^3$ . Calculate the % crystallinity in the sample. Would you expect that the structure of this sample has a large or small amount of branching? Explain.
6. Write the process used for the production of plastic items.
  - (a) Bags
  - (b) Toy trains
  - (c) Containers for liquids (small)
  - (d) Milk bottle
  - (e) Tea cups and saucers.
7. (a) What makes an unsaturated polyester resin unsaturated?

- (b) How are linear unsaturated polyesters cross linked? Write a structural formula chemical reaction to illustrate cross linking of an unsaturated polyester.
  - (c) What part of the structures of the acetals provides high strength? Explain.
8. (a) Explain the types of structure and molecular arrangement desired for producing synthetic rubbers.
- (b) What are the various additives added to raw rubber to get desired properties? Explain them.

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1. Explain various polymerization mechanisms. Differentiate between addition and condensation polymerization mechanisms.
2. (a) What characteristics must a monomer have in order to form a network Polymer, by chain polymerization. Explain.  
(b) Explain the process of crystallization in polymers.
3. (a) Discuss the function of
  - i. Fillers,
  - ii. Stabilizers and
  - iii. Antioxidants in polymers.(b) Explain why plasticizers are added to polymers?
4. (a) What do you mean by laminating? Explain what do you mean by high pressure laminating? How manufacturing of laminating plastic sheet is done.  
(b) Discuss the role of
  - i. Mica;
  - ii.  $H_2O_2$as additives in the polymers and polymerization.
5. Sketch and explain mer structures for the following polymers.
  - (a) Polyvinyl Chloride
  - (b) Expanded poly styrene
  - (c) Polytetrafluorethylene.
6. (a) What are the 2 major ingredients of thermo setting molding components.  
(b) What are the major advantages of phenolic plastics for industrial applications.  
(c) Using structural formulae. Write the reaction for phenol with formaldehyde to form a phenol formaldehyde molecule. (use 2 phenol molecules and one formaldehyde molecule). What kind of molecule is condensed off in this reaction
7. (a) In the designation Nylon6,6, what does the 6,6 stand for  
(b) What is the repeating structural unit for Nylon 6,6?  
(c) How can Nylons 6,9, 6,10 and 6,12 can be synthesized?

- (d) Write the reaction for the polymerization of nylon 6, from  $\epsilon$ -caprolactam.
8. (a) Enumerate the properties and uses of rubber.
- (b) Calculate the weight of sulphur required to cross link 54kg of polyisoprene. Consider the complete cross-linking from the initial stage of natural rubber.

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1. (a) Discuss in detail the Ionic and free radical initiation mechanism of addition polymerization.  
(b) Explain the different ways in which molecular weight of a polymer is Expressed.
2. (a) Explain on a structural basis the difference in the glass transition temperature of polyethylene ( $T_g = -140^\circ$ ); polyvinyl chloride( $T_g = 50^\circ \text{ C}$ ); poly styrene ( $T_g = 100^\circ \text{ C}$ ).  
(b) Explain the differences between configuration and conformation in relation to polymer chains.  
(c) Explain why the tendency of a polymer to crystallize decreases with increasing molecular weight.
3. What are plasticizers? Why are they used in some polymeric materials? How do plasticizers usually affect the strength and flexibility of polymeric materials? What type of plasticizers are commonly used for PVC.
4. Discuss the functions of the following additives on polymerization reaction.
  - (a) Inhibitors
  - (b) Cross link
  - (c) Blowing agents
  - (d) Colorants.
5. (a) What are the important properties and applications of polytetrafluoroEthylene?  
(b) Define an Engineering thermoplastic Why is this definition arbitrary?  
(c) How does increasing the temperature of thermoplastics affect their strength.  
(d) What changes in bonding structure occur as thermoplastics are heated.
6. Give and Explain the polymerization reactions for the following thermo setting plastics along with their properties and applications
  - (a) Phenol
  - (b) Urea- Formaldehyde resin.
7. (a) Describe how are the following plastics prepared from raw materials
  - i. Nylon6,6

- ii. PMMA
  - iii. Poly carbonates.
  - (b) Give the properties and applications of above plastics.
8. (a) How much sulphur must be added to 100gm of Butadiene rubber to cross link 3.0% of the mers. (Assume all sulphur is used to cross link the mers and only one 's' atom is involved in each cross linking bond).
- (b) You want to extrude a complex component from an elastomer should you Vulcanises the rubber before or after the Extrusion operation? Explain.

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1. (a) What are special properties of plastics that make them useful in Engineering materials?  
(b) What are linear polymers? Explain the differences between addition and condensation polymerization.
2. (a) Describe the relative tendencies of the following polymers to crystallize. Explain your answer.
  - i. Branched poly ethylene versus linear poly ethylene
  - ii. Poly ethylene versus polyethylene poly propylene.(b) Explain the function of the initiator catalyst for chain polymerization.
3. (a) Why are additives added to polymers.  
(b) Discuss various types of additives used in polymers, with examples and their function.
4. (a) What do you mean by laminating? Explain what do you mean by high pressure laminating? How manufacturing of laminating plastic sheet is done.  
(b) Discuss the role of
  - i. Mica;
  - ii.  $H_2O_2$as additives in the polymers and polymerization.
5. (a) How is the processibility of PVC improved to produce rigid PVC  
(b) Write the general reaction for the polymerization of polystyrene from styrene  
(c) What are the important applications of polystyrene.
6. (a) How much formaldehyde is required to completely crosslink 10kg of phenol to produce a thermosetting polymer. How much by product is evolved?  
(b) Describe the atomic structural arrangements of thermosetting plastics  
(c) Describe with the help of a neat sketch compression molding process for thermosetting plastics. What are its advantages and limitations.
7. (a) What is the repeating chemical structural unit for polymethyl methacrylate? By what trade name is PMMA commonly known.  
(b) What are the important properties of PMMA which make it an important industrial plastic.

8. (a) Enumerate the properties and uses of rubber.
- (b) Calculate the weight of sulphur required to cross link 54kg of polyisoprene. Consider the complete cross-linking from the initial stage of natural rubber.

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