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**PRESIDENCY UNIVERSITY
BENGALURU**

SCHOOL OF ENGINEERING

TEST 1

Winter Semester: 2021 - 22

Course Code: PET 406

Course Name: Polymer Technology

Program & Sem: B.Tech (Petroleum Engineering) & VI Sem

Date: 27-04-2022

Time: 10:00AM to 11:00AM

Max Marks: 30

Weightage: 15 %

Instructions:

- (i) Read the all questions carefully and answer accordingly.
(ii) Question Paper has THREE Parts, i.e. Part A, Part B, and Part C.

Part A [Memory Recall Questions]

Answer both the Questions. Each question carries 5 marks.

(2Qx 5M= 10M)

1. Choose the correct answer from the multiple choice questions

(5Qx 1M= 5M)

a. _____ is the monomer of polyethylene.

(A) $\text{CH}_2=\text{CH}_2$

(B) $\text{CH}_2=\text{CH}-\text{Cl}$

(C) $\text{CH}_2=\text{CHC}=\text{N}$

(D) $\text{CH}=\text{CH}-\text{CH}_3$

b. Trimer is formed by combination of _____.

A. 3 monomer molecules

B. a dimer and a monomer

C. 2 monomer molecules

D. Both a and b

c. Process of conversion of monomer to a polymer molecule is referred to as _____.

A. Polymerization

B. Monomerization

C. Combination reaction

D. None of the above

d. Functionality refers to number of _____ present in polymer.

A. Functional group

B. Reaction site

C. Bonding site

D. All of the above

e. _____ type of polymerization reaction mechanism results in production of by-products / condensates.

A. Addition reaction

B. Condensation reaction

C. Redox reaction

D. None of the above

2. Identify the statements to be true or false

(5Qx 1M= 5M)

- Define homopolymers.
- State the types of chain-growth polymerization
- Define the degree of polymerization.
- Differentiate between initiator and catalyst.
- Classify the following as addition and condensation polymers:
Bakelite, Polypropylene, Nylon and PVC

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries 2.5 marks.

(4Qx2.5M=10M)

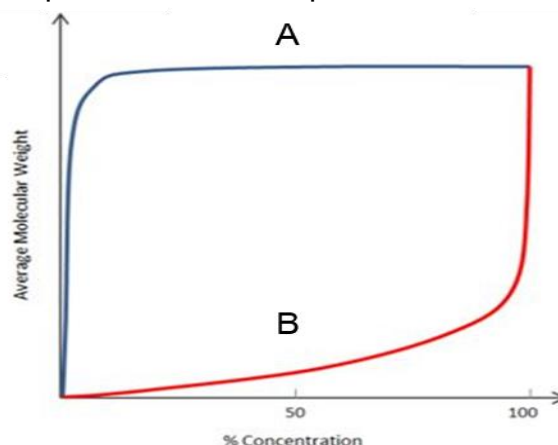
- Polyethylene and nylon are two polymers categorized into different categories based on their nature of chemical reactions. How can one differentiate between these two polymers?
- In a solution two types of polymers are present; Type A & Type B. Weight contribution for type A & B molecules is 30 gm and 50 gm respectively. What will be the number average molecular weight of the solution, if 10 molecules of type A and 20 molecules of type B are present?
- The polymerization of ethane requires benzyl peroxide. What is its role explain with structure?
- The conversion of monomer to polymer occurs during polymerization by fulfilling some conditions. State those conditions for polymerization.

Part C [Problem Solving Questions]

Answer both the Question. Each question carries 5 marks.

(2Qx5M=10M)

- Polymers available can be classified on the basis of synthesis, molecular structure, and chemical family. Discuss different types of polymers based on these classifications along with diagrams wherever required.
- The diagram shows the increase in molecular weight with the percent concentration of polymer.
 - Identify A and B type of polymerization mechanisms.
 - On the basis of the diagram explain the types of polymerization mechanisms including the difference in the formation process with examples.





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**PRESIDENCY UNIVERSITY
BENGALURU**

SCHOOL OF ENGINEERING

TEST 2

Winter Semester: 2021 - 22

Course Code: PET 406

Course Name: Polymer Technology

Program & Sem: B.Tech (Petroleum Engineering) & VI Sem

Date: 2nd June 2022

Time: 10:00 am to 11:00 am

Max Marks: 30

Weightage: 15 %

Instructions:

(iii) Read the all questions carefully and answer accordingly.

(iv) Question Paper has THREE Parts, i.e. Part A, Part B, and Part C.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries one marks.

(2Qx 5M= 10M)

Q1. Choose the correct option/options

(C.O.NO.2) (Knowledge) (1Qx 5M= 5M)

a. The change in stress of a polymer as a function of time at a fixed strain is known as:

- i) Fatigue
- ii) Creep
- iii) Stress relaxation
- iv) Fracture toughness

b. When the rate of cooling is increased during the solidification process, the glass transition temperature of a polymer _____.

- i) decreases
- ii) increases
- iii) stays unaltered
- iv) shows a non-monotonic dependence

c. Glass transition temperature of polymer can be measured by

- i) DSC
- ii) TGA
- iii) Spectrophotometer
- iv) GPC

d. Polymers below T_g behaves like

- i) Hard and Tough
- ii) Soft and flexible
- iii) Hard and brittle
- iv) Soft and tough

e. Increase in the number of aromatic groups along the backbone of the polymer chains

- i) Increases the flexibility and T_m
- ii) Increase the rigidity and T_m
- iii) Increase the hardness and reduces the T_m
- iv) Reduces the rigidity and increases the T_m

f. _____ is added to reduce the Tg of the polymer

i) Plasticizer

ii) Sulphur

iii) Antioxidant

iv) Carbon black

Q2. Briefly answer the following questions (C.O.NO.3) (Knowledge) (1Qx 5M= 5M)

a. Distinguish between polymer blend and polymer composite.

b. Name two fillers and two plasticizers

c. What do you mean by miscible and immiscible blend?

d. State the types of additives used for processing of the polymers.

e. Explain the terms: Upper critical solution temperature and lower critical solution temperature.

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries 4 marks.

(2Qx4M=8M)

Q3. A new manufacturing company starts producing polymer sheets for roofs. The manufacturer sends his latest batch of polymer sheets for quality test. This batch was rejected on the basis of observation that the brittleness of the sheet is increasing with time.

i) How can the manufacturer resolve this issue?

ii) To reduce the cost of production, explain briefly which type of additives can the manufacturer use?

iii) In what condition, manufacturer should add flame retardants and stabilizers?

(C.O.NO.3) (Comprehension)

Q4. Some polymers undergo degradation that reduces the average chain length during manufacturing like polyesters. Others, polyethylene for example, crosslink during degradation at high temperature.

i) What would the manufacturer observe in each of these situations?

ii) In order to prevent degradations, what steps must be adopted by the manufacturer?

(C.O.NO.2) (Comprehension)

Part C [Problem Solving Questions]

Answer the Question. The question carries 4 marks.

(3Qx4M=12M)

Q5. The following Figure 1. shows the stress-strain curve for a polymer.

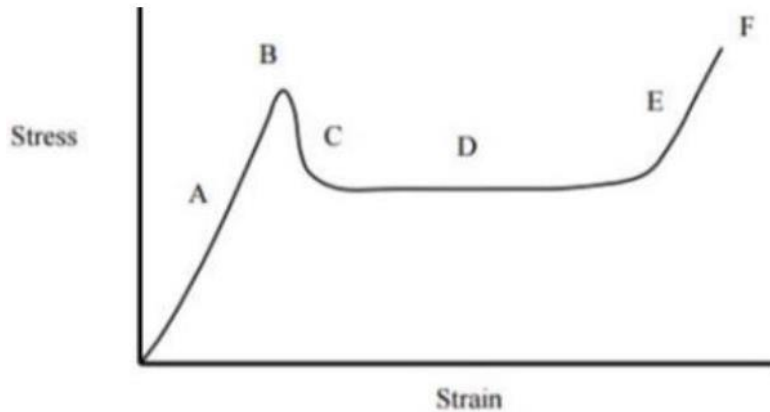


Figure 1.

- Identify and explain the region A, B, C, D, E and F?
- Redraw the curve and show elastic and plastic regions. (C.O.NO.2) (Application)

Q6. Predict and explain examples the effect, if any, of varying molecular weight, presence of crosslinking, chain stiffness, pendant groups and degree of short-chain branching on thermal and mechanical properties of polyethylene.

Q7. The stress-strain curves of tensile measurement for three different categories of polymers as shown in Figure 2.

- On the basis of its mechanical properties identify each type of polymer materials (A, B and C).
- Among the three polymers, explain which polymer will show higher strength and higher toughness?
- List some applications where they might be used for?

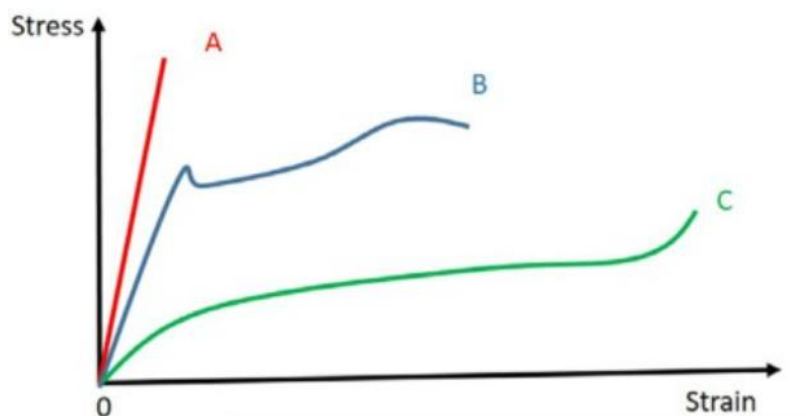


Figure 2.

(C.O.NO.2) (Application)



**PRESIDENCY UNIVERSITY
BENGALURU**

SCHOOL OF ENGINEERING

END TERM EXAMINATION

Winter Semester: 2021 - 22

Course Code: PET 406

Course Name: Polymer Technology

Program & Sem: B.Tech (Petroleum Engineering) & VI

Date: 1st July 2022

Time: 09:30 AM to 12:30 PM

Max Marks: 100

Weightage: 50 %

Instructions:

(v) Read the all questions carefully and answer accordingly.

(vi) Question Paper has THREE Parts, i.e. Part A, Part B, and Part C.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TEN marks.

(2Qx 10M= 20M)

Q1. Mark the following statements as True or False

(C.O. No. 1, 3) (Knowledge)

- i. A polymer is a chain of many small units joined together which are called monomers.
- ii. A lot of plastic pollutes our environment.
- iii. Degradable plastics break down into tiny pieces called microplastics.
- iv. Cotton is a natural polymer.
- v. In general viscosity of gases will increase with increasing temperature.
- vi. Thermosetting plastics do have a T_m , and they can have temperature resistance superior to that of thermoplastics.
- vii. Crosslinking is one of the most common methods of strengthening polymers and many thermosets have a cross-linked structure.
- viii. If shear stress is plotted as a function of a fluid's deformation rate, an increasing slope will imply fluid is dilatant.
- ix. The additive fillers are used to impart colour to the polymer.
- x. Viscosity is the proportionality factor that relates the shear stress to the shear strain.

Q2. Answer the following questions:

(C.O. No.1, 2) (Knowledge)

Explain the following terms

- i) Glass transition temperature
- ii) Spherulite
- iii) Viscoelasticity

iv) Polymer Composite

v) Upper critical solution temperature and lower critical solution temperature.

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries SIX marks.

(10Qx6M=60M)

Q3. Some polymers undergo degradation that reduces the average chain length during manufacturing like polyesters. Others, polyethylene for example, crosslink during degradation at high temperature.

- i) What would the manufacturer observe in each case scenario?
- ii) State briefly different types of degradation. (C.O.No.2) (Application)

Q4. Discuss the design characteristics of object obtained by compression moulding. Discuss advantage and disadvantage of compression moulding. (C.O.No.4) (Application)

Q5. Describe using graphical illustrations the difference between a semi-crystalline and amorphous polymer in terms of structure, appearance, melting behavior and glass transition temperature.

(C.O.No.2) (Comprehension)

Q6. Justify the following statement:

- i) Plasticizer enhances the flexibility and elongation property when added to polymer
- ii) A polymer was heated and found to have two melting points in DSC run. (C.O.No.3) (Comprehension)

Q7. With neat diagram discuss the polymeric materials:

- i) Hard and brittle,
- ii) Hard and strong,
- iii) Soft and weak and
- iv) Soft and tough (C.O.No.3) (Application)

Q8. Polymers available can be classified on the basis of synthesis, molecular structure, and chemical family. Discuss different types of polymers based on these classifications along with diagrams wherever required. (C.O.No.1) (Comprehension)

Q9. Polymers undergo degradation when exposed to heat, environment or mechanical stresses. Give your views on the two types of degradation of polymers with examples?

(C.O.No.3) (Comprehension)

Q10. Predict and explain examples the effect, if any, of varying molecular weight, presence of crosslinking, chain stiffness, pendant groups and degree of short-chain branching on thermal properties of polyethylene. (C.O.No.3) (Comprehension)

Q11. Early efforts during the growth of the plastics industry focused on the development of synthetic materials having comparable or superior properties to those of natural polymers. But due to cost effectiveness and environmental impact, industry is moving towards natural polymers. Give your views on the biopolymers or other naturally occurring polymers with examples.

(C.O.No.4) (Application)

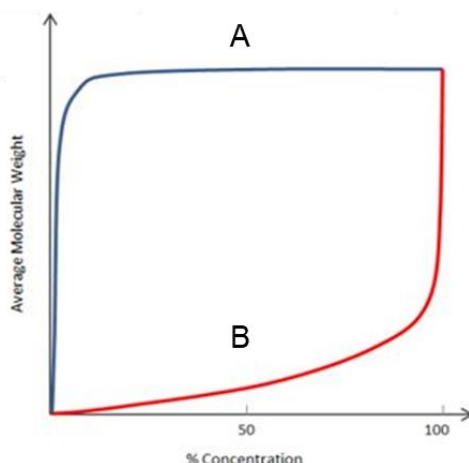
Q12. Polymers are large molecules made up of long chains of smaller monomer molecules. The conversion of monomer to polymer is termed as polymerization. Classify different techniques of polymerization with examples. (C.O.No.2) (Comprehension)

Part C [Problem Solving Questions]

Answer both the questions. The question carries TEN marks. (2Qx10M=20M)

Q13. The diagram shows the increase in molecular weight with the percent concentration of polymer.

- iii. Identify A and B type of polymerization mechanisms.
- iv. On the basis of the diagram explain the types of polymerization mechanisms including the difference in the formation process with examples.



(C.O.No.1) (Application)

Q14. (a) A nylon solution is prepared by step growth reaction. It has three type of polymer molecules based on length.

Species	Weight of specie “i” (Wi – gm)	Molar weight of specie “i” (Mi)
a	1	10000
b	2	50000
c	2	100000

Determine:

- i.) Number average molecular weight.
- ii.) Weight average molecular weight.
- iii.) Polydispersity index. (C.O.No.1) (Application)

(b) Calculate the mobility ratio for the fluid used in water flooding project, when if permeability of oil is 0.75D and permeability water is 0.35D, and viscosity of oil is 6cP and water is 1cP. If viscosity is increased by adding polymer to the water to 6cP, calculate the mobility ratio? In which case is the mobility ratio favourable? (C.O.No.4) (Application)