GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–III (NEW) EXAMINATION – WINTER 2024

Subject Code:3132606   **Date:21-11-2024**
Subject Name: Numerical methods & Viscoelastic models of Elastomers
Time:10:30 AM TO 01:00 PM   **Total Marks:70**

Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	The bulk modulus for water is given 2.1GPa. Compute the change in volume of 200ml water that is subjected to a stress of 2MPa.	**03**
	(b)	When a brass rod of diameter 6 mm is subjected to a tension of 5×10^3 N, the diameter changes by 3.6×10^{-4} cm. Calculate the longitudinal strain and Poisson's ratio for brass given that Y for the brass is 9×10^{10} N/m².	**04**
	(c)	Derive the equation for bulk modulus and young modulus.	**07**
Q.2	**(a)**	Describe the difference between Newtonian and non-Newtonian fluids based on their viscosity behavior.	**03**
	(b)	Explain the significance of intrinsic viscosity and how it relates to molecular weight.	**04**
	(c)	Evaluate the effectiveness of using Einstein's theory for calculating the viscosity of real polymer solutions compared to more complex models.	**07**

OR

	(c)	Draw the diagram of Oswald viscometer and explain in detail about the viscosity measurement procedure.	**07**
Q.3	**(a)**	Define the terms: (i) Enthalpy (ii) Entropy (iii) Ductility	**03**
	(b)	Explain how stretching rubber leads to a decrease in entropy. Why does this decrease occur?	**04**
	(c)	Discuss in detail about the explanation of pseudoplastic fluid behavior with example.	**07**

OR

Q.3	**(a)**	Write about the structure of an ideal rubber	**03**
	(b)	Compare the free energy change in rubber when it is stretched versus when it is relaxed. What roles do enthalpy and entropy play in this comparison?	**04**
	(c)	Discuss in detail about the explanation of viscoplastic fluid and dilatant behavior with example.	**07**
Q.4	**(a)**	Mention the key properties required for a material to be classified as an elastomer.	**03**
	(b)	Explain why elastomers must be above their glass transition temperature to exhibit rubbery behavior.	**04**
	(c)	Derive the equation of stress relaxation experiment for maxwell model.	**07**

OR

Q.4	**(a)**	Describe the significance of crosslinks in elastomeric materials.	**03**
	(b)	If a certain elastomer exhibits a low permanent set after being stretched, what can be inferred about its molecular structure?	**04**
	(c)	Derive the equation of creep experiment for Voight model.	**07**
Q.5	**(a)**	Define linear viscoelasticity in the context of the Boltzmann Superposition Principle.	**03**

	(b)	Describe how the Deborah number relates to the behavior of viscoelastic materials.	**04**
	(c)	Discuss in detail the factors influencing the Glass transition temperature.	**07**

OR

Q.5	**(a)**	Toluene behaves as a plasticizer for polystyrene. Estimate Tg of a polystyrene sample containing 40 vol% toluene.	**03**
	(b)	Explain how the Time-Temperature Superposition Principle relates temperature to the viscoelastic behavior of materials.	**04**
	(c)	Explain different plots showing variation of specific volume with temperature.	**07**

****