Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(New) EXAMINATION – SUMMER 2016

Subject Code:2142606 **Date:01/06/2016**

Subject Name:Viscoelasticity 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.**

Q.1		Answer the following.	14
	1	Define the term: "Stress".	
	2	Give the difference between the Young modulus and Bulk modulus.	
	3	Write the statement of the Hook's law.	
	4	Write the WLF equation.	
	5	Describe about the Memory fluid.	
	6	How the glass transition temp can affect the viscosity?	
	7	Which are principal differences between polymeric and metallic creep?	
	8	"Deborah number is related to material response time" Justify the statement.	
	9	Discuss about the Dynamic viscosity and Kinematic viscosity.	
	10	What is Internal Brownian Movement (IBM)?	
	11	Draw the schematic of relaxation for linear and branched polymers.	
	12	Give the typical range of shear rate of extruder process with their application.	
	13	Which fluids are showing the hysteresis?	
	14	Write the importance of Storage Modulus and Loss Modulus.	
Q.2	(a)	Derive the equation for the entropy generated force in polymer chain.	03
	(b)	An elastic wire is 2.5 mm diameter and 2 m long. A force of 12 N is applied to it and it stretches 0.3 mm. Determine the (i) Stress in the wire, and (ii) strain in the wire.	04
	(c)	Describe the Poisson's ratio in detail. What are the predictions of Poisson's ratio in terms of volume change?	07
		OR	
	(c)	A bar is 500 mm long and is stretched to 505 mm with a force of 50 kN. The bar is 10mm diameter. Calculate the stress and strain. The material has remained with elastic limit. Determine the modulus of elasticity.	07
Q.3	(a)	Short note on: "Relaxation Modulus".	03
	(b)	Describe about the Ideal Elastomer.	04
	(c)	List out the methods commonly used for measuring viscosity. Explain any one in detail.	07

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OR

Q.3 (a) Discuss about the response of elastic fluid under creep test. 03

(b) Explain the classification of purely viscous fluid by giving graphical representation. 04

(c) Describe the transitions and associated properties with respect to glass transition temperature. 07

Q.4 (a) List out the factors affecting glass transition temp. Explain any one. 03

(b) For an unknown polymer melt shear stress rate of shear data is given below. 04

τ x 10^{-3} ,n/m^2	345	400	434	469	503	552	565
γ, s^{-1}	8.64	17.3	25.9	34.6	43.2	51.8	60.5

Plot the graph and determine the type of fluid behavior.

(c) Derive the relationship between Viscosity and Energy dissipation. 07

OR

Q.4 (a) Explain about the effect of temperature on viscosity. 03

(b) Short note on: "Boltzmann superposition principle". 04

(c) Define the term: "Dynamic Complience". Also derive the relationship between the dynamic modulus and dynamic compliance. 07

Q.5 (a) A polymer sample has 0.2 m^2 cross sectional area is subjected to creep load of 10^5 N. The load is removed after 20 sec. Assuming that the Maxwell element accurately describes the behavior of polymer and that viscosity is 5 X 10^5P, while Young's modulus is 5 X 10^5 psi. Calculate the deformation recovered on the removal of dead load. 03

(b) Draw the schematic graph of creep & creep recovery for the Four parameter model. 04

(c) Discuss in detail about the linear Viscous Dash-pot Model. 07

OR

Q.5 (a) The relaxation time for a material that obeys the WLF equation at 0^0C is 10^4 s. Its relaxation time at T_g is 10^{12} s. What is the relaxation time of this material at 25^0 C? 03

(b) The constants for a four parameter model are 04
E_1 = 4 X 10^8 N/m^2, η_2 = 5 X 10^{10} N.s/m^2, E_3 = 10^7 N/m^2, and η_3 = 5 X 10^6 N.s/m^2 For creep and creep recovery experiment calculate the permanent set.
(Assume that the creep experiment lasted for 100 s and that the imposed stress is 10^4 N/m^2.)

(c) List the characteristics of Voigt Element model. Describe the Creep experiment for Voigt model. 07

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