Name:

Enrolment No:

UPES

End Semester Examination, December 2023

Course: Introduction to Material Modelling **Semester : V**

Program: B.Tech AMNT **Time : 03 hrs.**

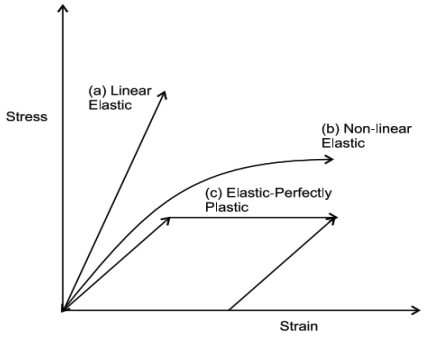
Course Code: MEMA 3009 **Max. Marks: 100**

Instructions:

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	For a symmetric tensor T and a vector v, show that T.v = v.T.	**4**	**CO1**
Q 2	Explain in brief: (a) Empirical Models, (b) Micromechanical Models, (c) Phenomenological Models.	**4**	**CO2**
Q 3	Define the term stretches and state various strain measures used in large deformation problems.	**4**	**CO2**
Q 4	Explain Bauschinger's effect and state under conditions it is used.	**4**	**CO3**
Q 5	Explain the difference between Isotropic hardening and Kinematic hardening of materials.	**4**	**CO2**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Show that a dot product of a tensor and a vector given as $T.v$ is also a vector.	**10**	**CO2**
Q 7	Explain the following constitutive models with appropriate examples using the figure provided below. 	**10**	**CO3**
Q 8	Explain the following terms with respect to the Viscoelastic behaviour: (a) Creep Compliance, (b) Relaxation Modulus, (c) Phase lag, Storage Modulus and Loss Modulus.	**10**	**CO4**
Q 9	Consider a state of stress at a following point:	**10**	**CO3**

	$\begin{matrix} 70 & 80 & 50 \\ 80 & -60 & 40 \\ 50 & 40 & 30 \end{matrix}$ **MPa** Consider another set of co-ordinate axes in which z' co-incides with z and z' is rotated counter clockwise by 40^0 from the x axis. Determine the stress components in new co-ordinate system.		
SECTION-C (2Qx20M=40 Marks)			
Q 10	A rectangular beam of size 200 mm x 300 mm has normal strain due to bending varying as $\varepsilon_x = 1.3 \times 10^{-5}$ y, where, y is in mm. Write the expression for normal stress σ_x, as a function of y and plot the normal stress distribution across the section if the beam is made from: (a) An elastic-plastic material having an yield stress $\sigma_y = 250$ MPa and a modulus of Elasticity, E = 200 GPa, (b) A bilinear material having yield stress $\sigma_y = 250$ MPa and Modulus of Elasticity $E_1 = 200$ GPa and $E_2 = 70$ GPa.	**20**	**CO4**
Q 11	The displacement component in a strained body are: $u = 0.01y^2z + 0.25xyz$, $v = 0.03x^2y + 0.04x^2yz$, $w = 0.25xyz - 0.05xyz^2$. Determine the strain tensor, rotation tensor, and angle of rotation at the point (-1, -1,3). **OR** Derive the expressions for $\mu'(\omega)$ and $\mu''(\omega)$ based on the Maxwell model of Viscoelastic Solid.	**20**	**CO3**