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**Question Paper Code: 92014**

M.E. DEGREE EXAMINATION, DECEMBER 2013.

Elective

CAD / CAM

01PCD523 - MECHANICAL BEHAVIOUR OF MATERIALS

(Regulation 2013)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. Write down the relationship between the plastic modulus (H) and the tangent modulus (T).
2. Distinguish between cylindrical and hydrostatic state of stress.
3. Briefly explain the *Bauschinger effect*.
4. What is meant by an octahedral plane?
5. Calculate the composite modulus for polyester reinforced with 60 vol% E-glass under iso-strain conditions. Take,  $E_{\text{polyester}} = 6.9 \times 10^3$  MPa and  $E_{\text{E-glass}} = 72.4 \times 10^3$  MPa.
6. List any two assumptions made in the elementary mechanics of materials models for effective moduli.
7. What are the advantages of dual phase steels?
8. What is responsible for the enhanced strength and ductility of TRIP steels?
9. Write short notes on polystyrene foam.
10. Compare the density, hardness and thermal conductivity of CBN and diamond.

PART - B ( 5 x 14 = 70 Marks)

11. (a) (i) Derive an expression for the maximum and minimum principal stresses for a biaxial state of stress. (10)
- (ii) Strain gauge measurements made on the free surface of a steel plate indicates that the principal strains are 0.004 and 0.001. Assuming  $E = 220$  GPa and  $\nu = 0.33$ , find the principal stresses. (4)

Or

- (b) Derive the equations of principal deviatoric stresses. (14)
12. (a) (i) Compare the maximum shear stress theory and distortion energy theory for a combined tension and torsion in a thin-walled tube. (7)
- (ii) Emphasize the advantage of using true strain with suitable examples. (7)

Or

- (b) Derive an expression that shows the relationship between stress and strain for an ideal plastic solid (Levy-Mises Equation). (14)
13. (a) Prove that the Halpin-Tsai equation for the case of very long fibres, yields the rule of mixtures (ROM). (14)

Or

- (b) A tensile stress of 15 MPa is to be applied to the composite material in a transverse direction to the fibres. Predict the strain that will result in the direction parallel to all fibres. Assume: 40vol% continuous, aligned, glass fibres in a thermoset polyester.  $E_f = 76$  GPa,  $\nu_f = 0.22$ ,  $E_m = 3.5$  GPa,  $\nu_m = 0.38$ . (14)
14. (a) (i) List out the methods of synthesizing nano - powders and explain any one method in detail. (7)
- (ii) What are HSLA steel and give the applications of HSLA steel. (7)

Or

- (b) (i) What factors would you consider in selecting materials for nuclear applications? Suggest materials for this application. Justify your selection. (7)
- (ii) What are the medical applications of shape memory alloys? (7)

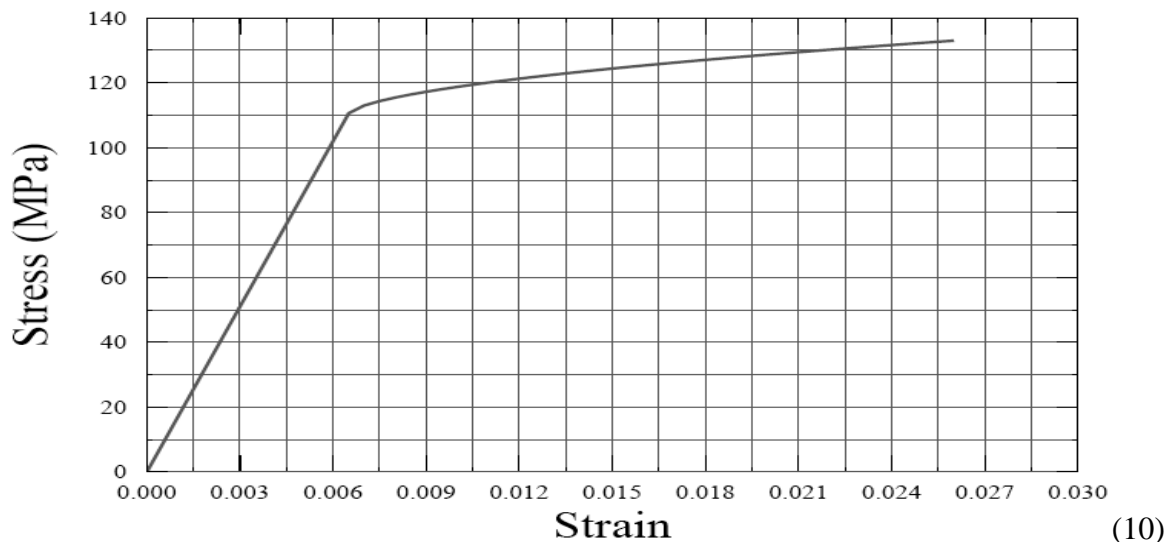
15. (a) (i) Discuss any two methods of preparing ceramic raw materials. (7)
- (ii) What is adhesive bonding? Explain the properties and applications of structural adhesives. (7)

Or

- (b) (i) Explain the steps involved in the production of ceramic products by agglomeration of particles? (8)
- (ii) Explain the terms Bulk polymerization, Solution polymerization and Suspension polymerization. (6)

PART - C ( 1 x 10 = 10 Marks)

16. (a) A typical stress-strain plot of a cortical bone is shown in Fig. Determine (a) the modulus of elasticity, (b) the yield stress at 0.15% offset, (c) the secant modulus (d) the tangent modulus and (e) the permanent strain at a stress level of 130 MPa.



Or

- (b) Analyze the requirement and substitution materials for the following applications
- (i) Tennis rackets
  - (ii) Surgical implants
  - (iii) Turnbuckle joints
  - (iv) Journal bearing
- (10)