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BME-017

B. TECH. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING) (BTMEVI)

Term-End Examination

June, 2019

BME-017 : STRENGTH OF MATERIALS

Time : 3 Hours *Maximum Marks : 70*

***Note** : Attempt any **seven** questions. All questions carry equal marks. Use of scientific calculator is permitted.*

1. Describe Hooke's law and elastic constants. 10

2. A rod is 3 m long at a temperature of 15°C. Find the expansion of the rod, when the temperature is raised to 95°C. If this expansion is prevented, find the stress induced in the material of the rod. Take $E = 1 \times 10^5 N/mm^2$, and $\alpha = 0.000012$ per degree centigrade. 10

3. At a point in a strained material the principal stresses are 100 N/mm^2 (tensile) and 60 N/mm^2 (compressive). Determine the normal

stress, shear stress and resultant stress on a plane inclined at 50° to the axis to major principle stress. Also determine the maximum shear stress at the point. Draw the Mohr circle. 10

4. A steel rod is 2 m long and 50 mm in diameter. An axial pull of 100 kN is suddenly applied to the rod. Calculate the instantaneous stress induced and also the instantaneous elongation produced in the rod. Take $E = 200 \frac{GN}{m^2}$. 10

5. A cantilever of length 2 m carries a uniformly distributed load of 1.5 kN/m run over the whole length and a point load of 2 kN at a distance of 0.5 m from the free end. Draw the S. F. and B. M. diagrams for the cantilever. 10

6. Prove that relation : 10

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

where :

M = Bending moment

I = Moment of inertia about NA

σ = Bending stress

E = Young's modulus

R = Radius of curvature

y = Distance from N. A.

7. Prove that for rectangular section subjected to eccentric load, the maximum and minimum stresses are given by : 10

$$\sigma_{max} = \frac{P}{A}\left(1 + \frac{6e}{b}\right)$$

$$\sigma_{min} = \frac{P}{A}\left(1 - \frac{6e}{b}\right)$$

where :

P = Eccentric load

A = Area of system

b = Width of section

e = Eccentricity

8. A beam of uniform rectangular section 200 mm wide and 300 mm deep is simply supported at its ends. It carries a uniformly distributed load of 9 kN/m run over the entire span of 5 m. If the value of E for the beam material is $1 \times 10^4 N/mm^2$, find : 10

(i) The slope at the supports

(ii) Maximum deflection

9. Derive the relation for a circular shaft when subjected to torsion as given below : 10

$$\frac{T}{J} = \frac{\tau}{R} = \frac{C\theta}{L}$$

Where :

T = Torque transmitted

J = Polar moment of inertia

τ = Max. shear stress

R = Radius of the shaft

C = Modulus of rigidity

θ = Angle of twist

L = Length of the shaft

10. A cylindrical pipe of diameter 2.0 m and thickness 2.0 cm is subjected to an internal fluid pressure of 1.5 N/mm^2. 10

Determine :

(i) Longitudinal stress

(ii) Circumferential stress developed in the pipe material