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ET-502(A)

B.Tech. Civil (Construction Management)/ B.Tech. Civil (Water Resources Engineering)

Term-End Examination

00207

December, 2017

ET-502(A) : STRENGTH OF MATERIALS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted. Assume any missing data suitably.*

1. (a) Find the Young's modulus of a rod of diameter 30 mm and of length 300 mm which is subjected to a tensile load of 60 kN and the extension of the rod is equal to 0·4 mm.

(b) 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 $\alpha = 0{\cdot}000012$ per degree Centigrade. 7+7

2. (a) A body is subjected to direct stresses in two mutually perpendicular directions accompanied by a simple shear stress. Draw the Mohr's circle of stresses and explain how you will obtain the principal stresses and principal plane.

(b) At a point in a strained material, the principal stresses are 100 N/mm^2 and 40 N/mm^2 compressive. Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of the major principal stress. What is the maximum intensity of shear stress in the material at the point ? *6+8*

3. (a) Define the following terms :

(i) Resilience

(ii) Strain energy

(iii) Gradually applied load

(iv) Spring constant (K)

(b) Calculate instantaneous stress produced in a bar 10 cm^2 in area and 3 m long by the sudden application of a tensile load of unknown magnitude, if the extension of the bar due to suddenly applied load is 1·5 mm. Also determine the suddenly applied load. Take $E = 2 \times 10^5$ N/mm^2. *4+10*

4. (a) What are the different types of beams ? Differentiate between a cantilever and a simply supported beam.

(b) A simply supported beam of length 6 m carries point loads of 3 kN and 6 kN at distances of 2 m and 4 m from the left end. Draw the shear force and bending moment diagrams for the beam. *4+10*

5. (a) Define the following terms :

(i) Neutral axis

(ii) Section modulus

(iii) Moment of resistance

(iv) Bending stress in a beam

(b) A steel plate of width 120 mm and of thickness 20 mm is bent into a circular arc of radius 10 m. Determine the maximum stress induced and the bending moment which will produce the maximum stress.

Take $E = 2 \times 10^5$ N/mm^2. *4+10*

6. (a) Prove that for a rectangular section subjected to eccentric load, the maximum and minimum stresses are given by

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

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

where

P = Eccentric load,

A = Area of the section

b = Width of section

e = Eccentricity

(b) A solid shaft of 150 mm diameter is used to transmit torque. Find the maximum torque transmitted by the shaft if the maximum shear stress induced in the shaft is 45 N/mm^2. *6+8*

7. (a) Define the following terms :

(i) Torsion

(ii) Torsional rigidity

(iii) Polar moment of inertia

(iv) Modulus of rigidity

(b) A hollow shaft of external diameter 120 mm transmits 300 kW power at 200 rpm. Determine the maximum internal diameter if the maximum stress in the shaft is not to exceed 60 N/mm^2. *4+10*

8. (a) A cylinder of internal diameter 2·5 m and of thickness 5 cm contains a gas. If the tensile stress in the material is not to exceed 80 N/mm^2, determine the internal pressure of the gas.

(b) A spherical vessel 1·5 m diameter is subjected to an internal pressure of 2 N/mm^2. Find the thickness of the plate required if maximum stress is not to exceed 150 N/mm^2 and joint efficiency is 75%. *7+7*

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