[Total No. of Questions - 9] [Total No. of Printed Pages - 3]

Dec-22-0123

ME-301 (Strength of Materials-I)
(ME, AE)

B.Tech-3rd (CBCS)

Time : 3 Hours **Max. Marks : 60**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note: (i) This question paper carries five sections. Attempt five questions in all, select one question from each sections A, B, C & D. Section E is compulsory.
(ii) Use of non-programmable calculator is allowed.
(iii) Assume missing data suitably if any and specify the same.

SECTION-A

1. A copper bar 25 mm diameter is completely enclosed in a steel tube 25 mm internal diameter and 40 mm external diameter. A pin, 10 mm in diameter is fitted transversely to the axis of the bar near each end, to secure the bar to the tube. Calculate the intensity of shear stress induced in the pin when the temperature of the whole is raised by 40 K. Take $E_c = 1\times10^5$ N/mm^2; $E_s = 2\times10^5$ N/mm^2, $\alpha_c = 18\times10^{-6}$ per K; $\alpha_s = 12\times10^{-6}$per K. (10)

2. At a point in a material, the stresses on two mutually perpendicular planes are 50 N/mm^2 (tensile) and 30 N/mm^2 (tensile). The shear stress across these planes is 12 N/mm^2. Using Mohr circle, find magnitude and direction of the resultant stress on a plane making an angle of 35° with the plane of the first stress. Find also, the normal and tangential stresses on this plane. (10)

SECTION-B

3. A 100 mm × 200 mm rolled steel joist of I-section has flanges 12 mm thick and web 10 mm thick. Find the safe uniformly distributed load that this section can carry over a span of 6 m if the permissible skin stress is limited to 160 N/mm^2. (10)

4. A solid shaft of 250 mm diameter has the same cross-sectional area as the hollow shaft of the same material with inside diameter of 200 mm.

   (a) Find the ratio of power transmitted by the two shafts for the same angular velocity and

   (b) compare the angles of twist in equal lengths of these shafts, when stressed to the same intensity. (10)

SECTION-C

5. The cross-section of a joist is a T-section, 120 mm × 200 mm × 12 mm with 120 mm side horizontal. Sketch the shear stress distribution and hence find the maximum shear stress if it has to resist a shear force of 200 kN. (10)

6. Find the slope and deflection of a simply supported beam carrying a (i) point load at the centre and (ii) uniformly distributed load over the entire length using moment-area method. (10)

SECTION-D

7. Explain the following theories of elastic failure with derivations and graphical representations:

   (i) maximum principal stress theory

   (ii) maximum strain energy theory (10)

8. Derive an expression for strain energy stored in a body when load is applied (i) suddenly (ii) with impact. (10)

SECTION-E

9. (i) Define bulk modulus and shear modulus.

(ii) What is complimentary shear stress? What is its significance?

(iii) What do you mean by the terms 'neutral axis' and 'neutral surface'?

(iv) What are the assumptions made in the theory of simple bending?

(v) Write down the torsion equation for a circular shaft subjected to torsion.

(vi) What assumptions are taken in the analysis of shear stress in beams?

(vii) What is Macaulay's method? Where is it used?

(viii) State maximum shear stress theory of failure.

(ix) State maximum shear strain energy theory of failure.

(x) Define the terms: resilience and proof resilience.

(2×10=20)