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CE 171302

Roll No. of candidate

2019

B.Tech. (CE) 3rd Semester End-Term Examination

ADVANCED SOLID MECHANICS

(New Regulation)

(w.e.f. 2017–2018)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer the following : (Fill in the blanks) $(10 \times 1 = 10)$

   (i) When a body is subjected to a direct tensile stress (σ) in one plane, the maximum shear stress is _____ the maximum normal stress.

   (ii) Tangential stress in a principal plane is _____.

   (iii) In simple bending, the stress in the beam varies _____.

[Turn over

(iv) The maximum shear stress developed in a beam of rectangular cross section is ———— times the average shear stress.

(v) The maximum deflection of a simply supported beam when a point load is applied in the centre of the beam is ————.

(vi) The shear stress at the centre of a circular shaft under torsion is ————.

(vii) The relation between equivalent length (L) and actual length (l) of a column for one end fixed and the other end free is ————.

(viii) A column may be considered as ———— when the slenderness ratio is more than 12.

(ix) Torque required to produce a twist of one radian per unit length of a shaft is called ————.

(x) Polar modulus for a solid shaft of diameter D is

2. Answer the following :

(a) 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, tangential stress and resultant stress on a plane inclined at 50° to the axis of major principal stress. Also determine the maximum shear stress at the point. (10)

(b) Explain 'pure bending' in case of a beam with an example. (5)

3. Answer the following :

(a) What are the assumptions made in Euler's column theory? Derive an expression for the Euler's Crippling load for a long column when both ends are hinged. (10)

(b) Explain the term 'equivalent length' of a column. Write its values for different end conditions of columns. (5)

4. Answer the following :

(a) A beam is of T-section of dimension 10 cm × 10 cm × 2 cm. The beam is simply supported on a span of 8 m. The beam carries a uniformly distributed load of 1.5 kN/m on the entire span. Determine the maximum tensile and compressive stresses. (10)

(b) Determine the diameter of a solid steel shaft which will transmit 90 kW at 160 rpm if the maximum shear stress is limited to 60 N/mm^2. (5)

5. Answer the following :

(a) What do you mean by the term neutral axis? Prove the relationship $\frac{M}{I} = \frac{E}{R} = \frac{f}{y}$ for simple bending. (10)

(b) A rectangular beam 100 mm wide and 250 mm deep is subjected to a maximum shear force of 50 kN, find the shear stress at a distance of 25 mm above the N.A. (5)

6. Answer the following:

(a) A simply supported beam of length 4 m carries a point load of 3 kN at a distance of 1 m from each end. If $E = 2 \times 10^5$ N/mm^2 and $I = 10^8$ mm^4 for the beam, then using conjugate beam method determine

(i) slope at each end and under each load

(ii) deflection under each load and at the centre. (10)

(b) Find the expression for the slope and deflection of a cantilever of length L which carries a point load W at the free end. (5)

7. Answer the following :

(a) For the section shown in Fig.1 determine the moment of inertia about its

(i) centroid along (x,y) axis.

(ii) new axes which is turned through an angle of 30° anticlockwise to the old axis. (10)

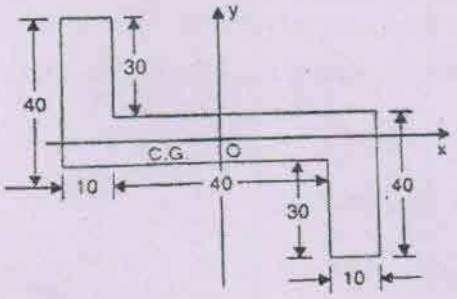

Fig.1

(b) Determine the principal moments of inertia about the centroid for the above case. (5)