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CE 171302

Roll No. of candidate | | | | | | | | | | |

2019

B.Tech. 3rd Semester End-Term Examination

Civil

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

   (a) Principal plane is a plane on which shear stress is ————

   (b) A body is subjected to a direct tensile stress (σ) in one plane. The shear stress is maximum at a section inclined at ———— to the normal of section.

   (c) When a beam is subjected to a bending moment, the stress in a layer is ———— proportional to the distance from the neutral axis.

[Turn over

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

(e) The maximum deflection of a simply supported beam loaded with uniformly distributed load of w per unit length is ————

(f) The shear stress at the outermost fibres of a circular shaft under torsion is ————

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

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

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

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

2. Answer the following :

(a) A point in a strained element consists of normal stresses of 200 N/mm^2 (tensile) and 100 N/mm^2 (tensile) on two mutually perpendicular planes, together with a shear stress across these planes of 50 N/mm^2. With the help of Mohr's circle, determine the magnitude and direction of the resultant stress on an oblique plane making an angle 30° with the plane of 200 N/mm^2 tensile stress. Find also the normal and tangential stress on this plane. (10)

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

3. Answer the following :

(a) A 1.5 m long circular column of 50 mm diameter had one end fixed and other end free. Taking a factor of safety = 3, calculate the safe load using

(i) Rankine's formula taking f_c = 560 N/mm^2 and Rankine's constant = 1/1600

(ii) Euler's formula taking

E = 1.2×10^5 N/mm^2. (10)

(b) Derive the expression for maximum torque transmitted by a circular solid shaft. (5)

4. Answer the following :

(a) A hollow circular shaft of diameter ratio 3/8 (internal to external) is to transmit 375 kW power at 100 rpm. The maximum torque being 20% greater than the mean. The shear stress should not exceed 60 N/mm^2 and twist in a length of 4 m not to exceed 2°. Calculate the external and internal diameters. Assume modulus of rigidity as 0.85×10^5 N/mm^2. (10)

(b) What do you mean by Section Modulus? Derive an expression for Section Modulus for a rectangular section. (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 150 mm deep is simply supported over a span of 4 m. If shear force at a section of the beam is 4,500 N, 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 1m 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 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 uniformly distributed load w/unit length over the entire length by Moment Area method. (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 axis which is turned through an angle of 30° anticlockwise to the old axis. (10)

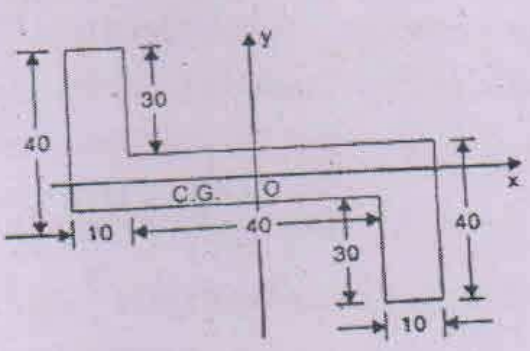

Fig.1

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