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CE 181302

Roll No. of candidate

2019

B.Tech. 3rd Semester End-Term Examination

SOLID MECHANICS

(New Regulation)

(w.e.f. 2017-2018) and New Syllabus (w.e.f. 2018-2019)

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 questions : (10 × 1 = 10)

   (i) The shear stress on the principal plane is
   - (a) Maximum
   - (b) Minimum
   - (c) Zero
   - (d) Negative

   (ii) The constant of stress-strain relationship in case of shear stress-shear strain is called
   - (a) Young's modulus
   - (b) Modulus of rigidity
   - (c) Modulus of shear
   - (d) Stress modulus

[Turn over

(iii) Mark the correct relationship among E, G and K

(a) $E = \frac{9KG}{G + 3K}$

(b) $G = \frac{9EG}{G + 3K}$

(c) $K = \frac{9EG}{G + 3E}$

(d) $E = \frac{9KG}{1 - 3KG}$

(iv) Proof stress is applicable to

(a) Ductile material with clear yield point

(b) HYSD bars with no clear yield point

(c) Plastic material

(d) Elastic material

(v) Shear stress distribution in beam cross-section is

(a) Linear

(b) parabolic

(c) Elliptical

(d) Circular

(vi) Plane section before bending remains plane after beading in case of pure bending of beam translates into

(a) Linear variation of Strain across the section

(b) Linear variation of Stress across the section

(c) E value constant

(d) G value constant

(vii) Beam column is observed in

(a) Axially loaded column

(b) Column with axial load as well as bending moment

(c) Column with circular cross section

(d) Columns with rectangular cross-section

(viii) In a gas filled LPG cylinder

(a) Only hoop stress is present

(b) Only longitudinal stress is present

(c) Both hoop stress and longitudinal stress is present

(d) Neither hoop stress nor longitudinal stress is present

(ix) Torsional stress is explained in terms of

(a) Shear stress

(b) Bending stress

(c) Axial tensile stress

(d) Axial compressive stress

(x) Which is the better performing cross-section for shaft with the same (net) cross-sectional area

(a) Solid circular shaft

(b) Hollow circular shaft

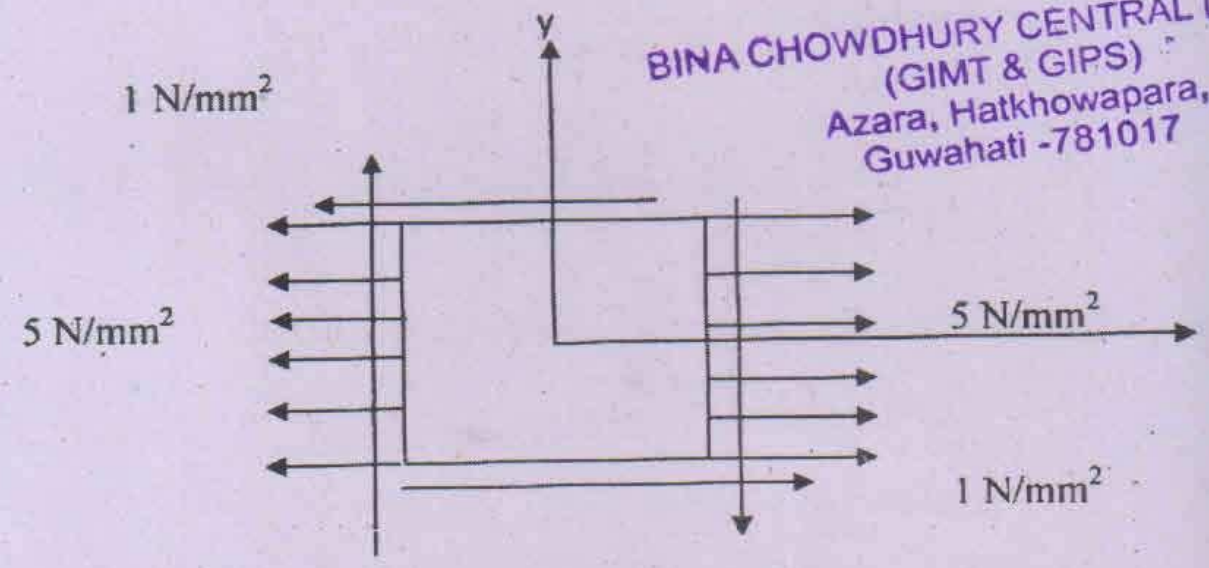
(c) Square shaped cross-section

(d) Hollow square shaped shaft

2. (a) A truss member is subjected to an axial force of 50 kN. If the material of the truss is mild steel of yield stress of allowable stress 140 MPa, determine the cross-sectional area necessary for the truss member. (5)

(b) Establish the relationship between the elastic constants E and G. (10)

3. (a) A plane stress element in a beam is subjected to 5 N/mm^2 of tensile stresses in X direction directions and shear stress of 1 N/mm^2. Determine the principal stresses on and the plane at which it acts. (5)



(b) Construct the Mohr's circle for the above stress condition and evaluate the principal stresses. (10)

4. (a) State the assumptions of theory of simple bending. (5)

(b) A prismatic beam of rectangular cross section is subjected to a bending moment of 50 kNm and a shear force of 30 kN at a section. Draw the bending stress and shear stress profiles across the section. (5 + 5)

5. (a) State Rankine-Gordon formula and explain the relationship between allowable average compressive stress and slenderness ratio. (3 + 5)

(b) Given allowable compressive strength of steel in bending and direct compression as 140 N/mm^2 and 130 N/mm^2 respectively, determine the suitability of a column of ISWB 400 with cross sectional area as 8501 mm^2, and section modulus about bending axis as 1171300 mm^3. The column is subjected to bracketed load of 480 kN with associated bending moment 40 kNm. (7)

6. (a) Calculate safe internal gas pressure for a gas cylinder of mild steel with plate thickness 2.5 mm., if the mean diameter of the cylinder is 600 mm and allowable stress in tension is 140 N/mm^2. (6)

(b) A cylindrical container is made of steel plate of thickness 6 mm has reivetted joint at a pitch of 40 mm. The rivet diameter is 18 mm. Calculate the ultimate strength of the joint and the efficiency of the joint. Given tensile strength of steel is 350 N/mm^2, shear strength of rivets is 300 N/mm^2 and crushing (bearing) strength of steel is 650N/mm^2. (9)

7. (a) A hollow steel tube outside diameter d_o, and inside diameter d_i is to be used as a torque dynamometer. It is desired to attain an angle of twist 1° per 300 mm of length per 1 kN-cm torque without exceeding an allowable stress $\tau_w = 400$ N/mm^2. What is the required value of d_o, and d_i? (8)

(b) A steel shaft 6 mm in diameter turns 10,000 rpm. What is the maximum power that such shaft may develop if the assigned working stress in shear is 330 N/mm^2? (7)
