Total No. of printed pages = 3

CE 171204

Roll No. of candidate

2022

B.Tech. 2nd Semester End-Term Examination

STRENGTH OF MATERIALS

(New Regulation)

Full Marks – 70   Time – Three hours

The figures in the margin indicate full marks

for the questions.

Question No. 1 is compulsory. Solve any *four* from question 2 to question 7.

1.   Fill in the blanks :   (10 × 1 = 10)

   (i)   The shear stress on the principal plane is _____.

   (ii)   Modulus of rigidity is the ratio of _____.

   (iii) Write the relationship between E, G and K.

   (iv)   The rate of change of bending moment is equal to _____ of the section.

   (v)   Maximum slope of a cantilever beam having a uniformly distributed load over the entire span is _____.

   (vi)   Angle of twist of a circular shaft is given by _____.

   (vii) The column may be considered as _____ when the slenderness ratio is less than 12.

   (viii) The moment at the hinge support is _____.

   (ix)   The polar modulus for a solid shaft of diameter D is _____.

   (x)   The buckling load for a given material depends on _____.

[Turn over

2. (a) Define bulk modulus. Derive the relation between bulk modulus, modulus of elasticity and Poisson's ratio.

(b) A bar 12 mm diameter is acted upon by an axial load of 20 kN. The change in diameter is measured as 0.003mm. Determine the Poisson's ratio, modulus of elasticity and bulk modulus. The value of modulus of rigidity is 80GPa.

(c) What do you mean by tensile, compressive and shear force? (6+6+3=15)

3. (a) What is Hooke's law? Discuss Volumetric Strain.

(b) Explain temperature stresses.

(c) A steel rod of diameter 10mm and length 1400 mm is stress free at 20°C. Find stress in the rod if temperature rises to 70°C.

(i) If the ends are fully fixed.

(ii) If one of the ends yields by 0.2 mm.

Take $\alpha = 12 \times 10^{-6}/°C$ and $E = 200$ GPa. (3+3+9=15)

4. (a) Calculate the shear force and the free end of the cantilever beam of length "L" carrying a uniformly distributed load of 'w' per unit length.

(b) Draw a beam of length 4m fixed at left support and hinge at the other support. Beam is loaded with a uniformly distributed load of 4kN/m over half of the span from the fixed support. In addition, an point load of 40 kN is acted on one-third span from fixed support.

(c) A simply supported beam AB (10 m long) is supported at its end A and B. It carries two point loads of 5kN at 3 m from both supports A and B. Also a uniformly distributed load of 1 kN/m is acting between the point loads. Draw shear force and bending moment diagram for the given beam. (2+3+10=15)

5. (a) What are the stresses induced in a thin cylindrical shell subjected to internal pressure? Write the expressions for them.

(b) A thin cylinder of internal diameter 1.2 m contains fluid at a pressure of 2kN/m². What should be the thickness of cylinder if the longitudinal and circumferential are not to exceed 28 kN/m² and 45 kN/m² respectively?

(c) Show that the volumetric strain of a cylindrical shell is the sum of longitudinal strain and twice of hoop strain. (4+4+7=15)

CE 171204   2

6. (a) Write the assumptions of the theory of pure torsion applied to the shaft.

   (b) What is polar modulus? If a shaft rotating at a speed 'N' rpm is transmitting 'P' kW power and maximum torque on the shaft is 'T' Nm, evaluate the expression for the power transmitted by the shaft.

   (c) Find the torque, which a shaft of 100 mm diameter can transmit safely, if the shear stress is not to exceed 100 N/mm². (5+5+5=15)

7. (a) What is long and short column? Write the expression of Euler's crippling load for different end conditions of column.

   (b) Define crippling load, slenderness ratio, and effective length.

   (c) Derive the equation for critical load of a column with both ends fixed.

(6+3+6=15)