Reg. No. : | | | | | | | | | | |

Question Paper Code: 54075

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2017

Fourth Semester

Mechanical Engineering

15UME405 - STRENGTH OF MATERIALS

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The deformation of the bar per unit length in the direction of the force is known as

   (a) linear strain (b) lateral strain (c) volumetric strain (d) none of these

2. A steel bar of 5 mm is heated from 15° C to 40° C and it is free to expand. The bar will induce

   (a) no stress (b) shear stress
   (c) tensile stress (d) compressive stress

3. In a loaded beam, the point of contra-flexure occurs at a section where

   (a) bending moment is minimum (b) bending moment is zero or changes sign
   (c) bending moment is maximum (d) none of these

4. The neutral axis of the cross-section a beam is that axis at which the bending stress is

   (a) zero (b) minimum
   (c) maximum (d) infinity

5. The load required to produce a unit deflection in a spring is called

   (a) flexural rigidity (b) torsional rigidity (c) spring stiffness (d) none of these

6. Two closely coiled helical springs '*A*' and '*B*' are equal in all respects but the number of turns of spring '*A*' is half that of spring '*B*' The ratio of deflections in spring '*A*' to spring '*B*' is

(a) 1/8 (b) 1/4 (c) 1/2 (d) 2

7. A column with maximum equivalent length has

(a) both ends hinged (b) both ends fixed
(c) one end fixed and the other end hinged (d) none of these

8. If the slenderness ratio for a column is 100, then it is said to be a _____ column.

(a) long (b) medium (c) short (d) none of these

9. A boiler shell 200 cm diameter and plate thickness 1.5 cm is subjected to internal pressure of 1.5 MN/m, and then the hoop stress will be

(a) 30 MN/m² (b) 50 MN/m² (c) 100 MN/m² (d) 200 MN/m²

10. A thin cylindrical shell of diameter (d) length (l) and thickness (t) is subjected to an internal pressure (p). The longitudinal stress in the shell is

(a) pd/t (b) pd/2t (c) pd/4t (d) none of these

PART - B (5 x 2 = 10 Marks)

11. Define Hooke's law.

12. Define sagging bending moment.

13. Define stiffness of spring and mention its unit in SI system.

14. Define effective length of shaft.

15. What is principal plane and stress?

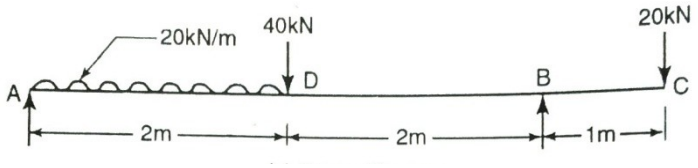
PART - C (5 x 16 = 80 Marks)

16. (a) A mild steel rod of 25 mm diameter and 400 mm long is encased centrally inside a hollow copper tube of external diameter 35 mm and inside diameter 30 mm. The ends of the rod and tube are rigidly attached and the composite bar is subjected to an axial pull of 40 kN. Determine: (i) the stress in the rod and tube, and (ii) load carried by each bar. Take E = 2 x 10^5 N/mm^2 and for copper = 1 x 10^5 N/mm^2. (16)

Or

(b) The following data relate to a bar subjected to a tensile test: Diameter of the bar = 30 mm, Tensile load P = 54 kN, Gauge length l = 300 mm, Extension of the bar δl = 0.112 mm, Change in diameter δd = 0.00366 mm, Calculate (i) Poisson's ratio, (ii) The values of three moduli. (16)

17. (a) Draw the shear force and bending moment for the overhanging beam shown in figure. Clearly indicate point of contra flexure.



(16)

Or

(b) A simply supported beam of length 6 m carries point load of 3 KN and 6 KN at distances of 2 m and 4 m from the left end. Draw the shear force and bending moment diagrams for the beam? (16)

18. (a) A shaft is required to transmit 245 KW power at 240 rpm, the maximum torque may be 1.5 times the mean torque. The shear stress in the shaft should not exceed 40 N/mm^2 and the twist 1^o per meter length. Determine the diameter required if, (i) The shaft is solid (ii) The shaft is hollow with external diameter twice the internal diameter. Assume G = 80 KN/mm^2. (16)

Or

(b) A solid shaft is to transmit 300 kW at 120 rpm. If the shear stress is not to exceed 100 MPa, Find the diameter of the shaft, What percent saving in weight would be obtained if this shaft were replaced by a hollow one whose internal diameter equals 0.6 of the external diameter, the length, material and maximum allowable shear stress being the same? (16)

19. (a) A both ends hinged cast iron hollow cylindrical column 3 m in length has a critical buckling load of P kN. When the column is fixed at both the ends, its critical buckling load raise by 300 kN more. If ratio of external diameter to internal diameter is 1.25 and E = 100 GPa determine the external diameter of column. (16)

Or

(b) Compare the crippling loads given by Rankine's and Euler's formula for tubular strut 2.25 m long having outer and inner diameters of 37.5 mm and 32.5 mm loaded through pin-joint at both ends. Take yield stress at 315 x 10^6 N/m^2, α =1/7500 and E = 20 x 10^{10} N/m^2. (16)

20. (a) A closed cylindrical vessel made of steel plates 4mm thick which plane ends, carried fluid under a pressure of 3N/mm^2. The dia. of cylinder is 25cm and length is 75cm, calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and volume of the cylinder. E = 2x10^5N/mm^2 and poisson's ratio = 0.286. (16)

Or

(b) At a point in an elastic material a direct tensile stress of 70 N/mm^2 and a direct compressive stress of 50 N/mm^2 are applied on planes at right angles to each other. If the maximum principal stress in the material is limited to 75 N/mm^2, find out the shear stress that may be allowed on the planes. Also determine the magnitude and direction of the minimum principal stress and the maximum shear stress. (16)