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

Question Paper Code: 50745

B.E. / B.Tech. DEGREE EXAMINATION, MAY 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. Strain energy is the

   (a) energy stored in a body when strained within elastic limits
   (b) energy stored in a body when strained upto the breaking of a specimen
   (c) maximum strain energy which can be stored in a body
   (d) proof resilience per unit volume of a material

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. If the shear force along a section of a beam is zero, the bending moment at the section is

   (a) zero (b) maximum
   (c) minimum (d) average of maximum-minimum

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 shear stress at any section of a shaft is maximum

   (a) at the centre of the section (b) at a distance $r/2$ from the centre
   (c) at the top of the surface (d) at a distance 3/4 r from the centre

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. Euler's formula holds good only for

(a) short columns (b) long columns
(c) both short and long columns (d) weak columns

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. The maximum shear stress, in the given figure, is equal to _____ of the Mohr's circle.

(a) radius (b) diameter (c) circumference (d) area

PART - B (5 x 2 = 10 Marks)

11. Define Hooke's law.

12. What is point of contra flexure?

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

14. What is slenderness ratio of a column?

15. What is principal plane and stress?

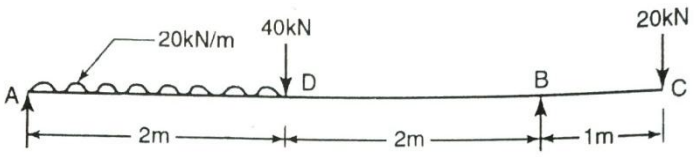
PART - C (5 x 16 = 80 Marks)

16. (a) A reinforced concrete column 500 mm x 500 mm in section is reinforced with 4 steel bars of 20 mm diameter, one in each corner. The column is carrying a load of 750 kN. Determine the stresses in concrete and steel bars. Take E_s = 210 GPa and E_c = 14 GPa. Also, calculate load carried by steel and concrete. (16)

Or

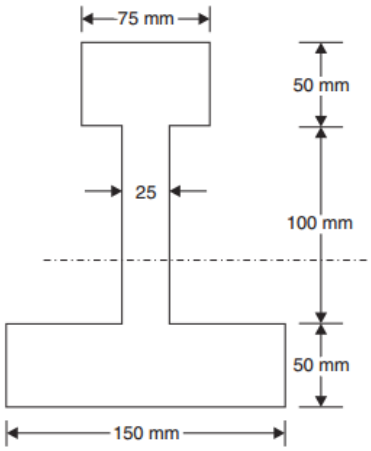
(b) The following data relate to a bar subjected to a tensile test: Diameter of the bar = 30 mm, Tensile load P = 54 kN, Gauge length l = 300 mm, Extension of the bar δl = 0.112 mm, Change in diameter δd = 0.00366 mm, Calculate (i) Poisson's ratio, (ii) The values of three moduli. (16)

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) The cross-section of a cast iron beam is as shown in figure. The top flange is in compression and bottom flange is in tension. Permissible stress in tension is 30 N/mm^2 and its value in compression is 90 N/mm^2. What is the maximum uniformly distributed load the beam can carry over a simply supported span of 5 m? (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 closed coiled helical spring has a stiffness of 10 N/mm. Its length when fully compressed with adjacent coils touching each other is 400 mm. the modulus of rigidity of the material of the spring = 80 GPa. (i) Determine the wire diameter and mean coil diameter if their ratio is 1/10 (ii) If the gap between any two adjacent coils is 2 mm. What maximum load can be applied before the spring becomes solid (i.e.) adjacent coils touch (iii) What is the corresponding maximum shear stress in the spring? (16)

19. (a) A 1.5 m long column has a circular cross section of 5 cm diameter. One of the ends of the column is fixed in direction and position and the other end is free. Take factor of safety as 3, calculate the safe load using (i) Rankine's formula, take yield stress = 560 N/mm^2 and Rankine's constant α =1/1600 (ii) Euler's formula, Elastic modulus 1.2 x 10^5 N/mm^2. (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 = 2x$10^5$$N/mm^2$ and poisson's ratio = 0.286. (16)

Or

(b) The state of stress at a point in a strained material is as shown in figure. Determine: (i) The direction of the principal planes (ii) The magnitude of principal stresses (iii) The magnitude of the maximum shear stress and its direction. (16)