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

Question Paper Code: 43104

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2022

Third Semester

Civil Engineering

14UCE304 - MECHANICS OF SOLIDS – I

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 1 = 10 Marks)

1. Within elastic limit in a loaded material, stress is_____

   (a) inversely proportional to (b) directly proportional to strain
   (c) equal to strain (d) not equal to strain

2. Strain energy is the

   (a) energy stored in a body when strained within elastic limits
   (b) energy stored in a body when strained up to 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

3. A perfect frame should satisfy the relation_____

   (a) $m=2j+3$ (b) $m=3j-4$ (c) $m= 2j-3$ (d) $m=3j-2$

4. Moment of inertia of a circle of diameter d about its centroidal X axis is _____

   (a) πd^4 /64 (b) πd^4 /50 (c) πr^4 / 64 (d) πr^4 / 35

5. If a cantilever beam of span (L) carries a point load (W) at free end of the beam then the shear force diagram will be

   (a) rectangle (b) two equal and opposite rectangle
   (c) right angled triangle (d) two equal and opposite triangle

6. The shear stess required to cause plastic deformation of solid metal is called

   (a) proof stress (b) flow stress (c) rupture stress (d) ultimate stress

7. Strain energy is the

   (a) energy stored in a body when strained within elastic limits
   (b) energy stored in a body when strained up to 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

8. In the torsion equation, the term J/R is called as

   (a)shear modulus (b) section modulus (c) polar modulus (d) none of these

9. In Mohr's circle of stress, the diameter represents

   (a) maximum shear stress (b) deviator stress
   (c) major principal stress (d) minor principal stress

10. Mohr's circle is used to determine the stresses on an oblique section of a body subjected to

    (a) direct tensile stress in one plane accompanied by a shear stress
    (b) direct tensile stress in two mutually perpendicular directions
    (c) direct tensile stress in two mutually perpendicular directions accompanied by a simple shear stress
    (d) all of the above

PART - B (5 x 2 = 10 Marks)

11. State the relationship between Young's modulus and Rigidity modulus.

12. Explain the concept of analysis of tresses carrying horizontal loads in method of joints.

13. Enumerate some statically indeterminate beams with examples.

14. Write the assumptions in the theory of pure torsion.

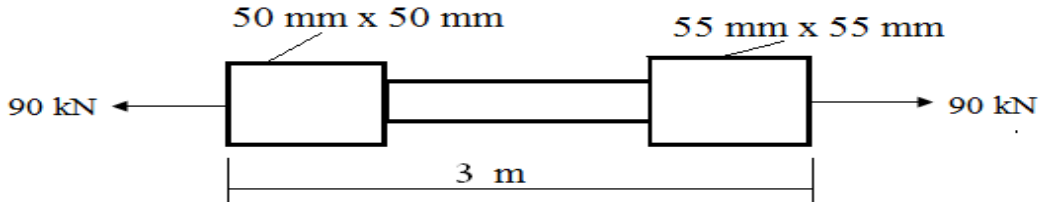
15. Define principal plane.

PART - C (5 x 16 = 80 Marks)

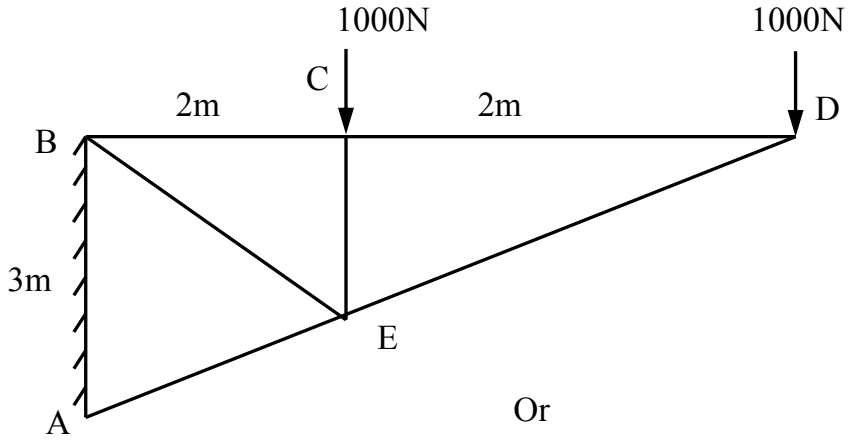
16. (a) A steel bar is placed between two copper bars each having the same area and length as t he steel bar at 16^oC. At this stage, they are rigidly connected together at both the ends. When temperature raised to 316 ^oC, the length of the bar increases by 1.5 *mm*. Determine the final stress and strain in the bars. E_S = 210 GN/m^2, E_C = 110 GN/m^2, α_S = 0.000012 per°C, α_C = 0.0000175 per°C. (16)

Or

(b) A bar of length 3 *m* has enlarged square ends of same length is loaded with an axial force 90 *kN* as shown in the figure. The cross sectional dimensions of the enlarged portions are given in the diagram. If the middle portion of the bar is also of square section, find the size and length of the middle portion, if the stress there is 150 MN/m^2, the total elongation of the bar is 0.50 *mm*. Take $E = 200\ GN/m^2$. (16)

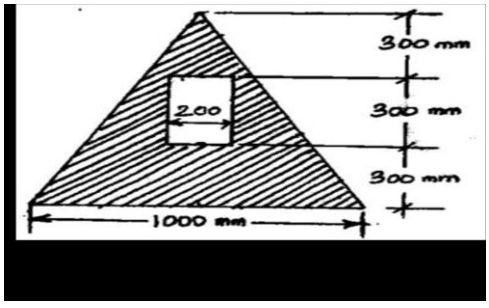


17. (a) Determine the member forces in a truss structure as shown in figure by any suitable method. (16)

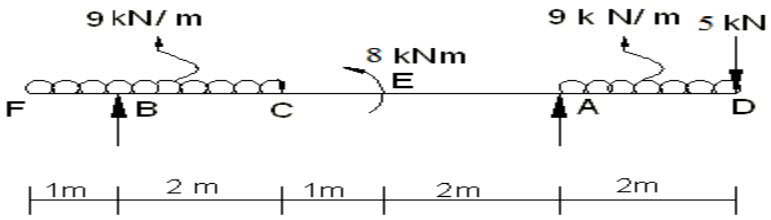


Or

(b) Find the moment of inertia of the shaded area shown in below figure about the vertical and horizontal centroidal axes. The width of the hole is 200 *mm*. (16)



18. (a) Draw shear force and bending moment diagram for an overhanging beam shown in the figure. (16)



Or

(b) A cantilever of length 2.0 *m* carries a uniformly distributed load of 1 *kN/m* run over a length of 1.5 *m* from the free end. Draw the shear force and bending moment diagram for the cantilever. (16)

19. (a) A solid shaft is subjected to a torque of 50 *kNm*. If angle of twist is 0.6^o per metre length of the shaft and the shear stress is not to be allowed to exceed 85 MN/m^2. Find suitable diameter of the shaft, Final maximum shear stress and maximum shear strain in the shaft. Modulus of rigidity of the material of the shaft is 80 GN/m^2. (16)

Or

(b) An open coil helical spring consists of 12 *coils*, each of mean diameter 50 *mm*. The wire forming the coil being 5 *mm* in diameter. Each coil makes an angle of 30^o with the plane perpendicular to the axis of the spring. Determine the load required to elongate the spring by 30 *mm* and the bending stress caused by that load. Young's modulus of elasticity and modulus of rigidity of the material of the spring is 200 GN/m^2 and 82 GN/m^2 respectively. (16)

20. (a) A body is subjected to stresses on two mutually perpendicular planes are 30 MN/m^2 (tensile) and 20 MN/m^2 (tensile). Shear stress across this planes are 8 MN/m^2. Using Mohr's circle method find the magnitude and direction of the resultant stress on the plane making an angle of 35^o with the plane of first stress and also find the normal and tangential stress on the plane. (16)

Or

(b) At a point in a strained material the principle stresses are 100 N/mm^2 (tensile) and 60 N/mm^2 (compressive). Determine the normal stress, shear stress and resultant stress on a plane inclined at 50° to the axis of major principle stress. Also determine the maximum shear stress at the point. (16)