Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

THIRD SEMESTER B.TECH DEGREE EXAMINATION (S), FEBRUARY 2023

CIVIL ENGINEERING

(2020 SCHEME)

Course Code : 20CET201

Course Name: Mechanics of Solids

Max. Marks : 100 **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Draw the stress strain diagram of mild steel bar and mark the salient points
2. What are the different types of stress and strain?
3. Define resilience, proof resilience and Bulk modulus.
4. Comment on the type and nature of forces that are acting on a thin cylinder
5. A cantilever beam of span L, fixed at the left end, carries a clockwise moment M at its centre and a point load at the free end. Draw the SFD and BMD
6. Explain the following:
   i) Shear force and bending moment in a beam
   ii) Hogging and sagging moments.
   iii) Point of contra flexure.
7. What do you mean by beams of uniform strength?
8. List down the assumptions of simple bending
9. Write down the expression for normal stress on a plane inclined at an angle θ to x axis and subjected to normal stresses in X and Y directions
10. Define
    i) Slenderness ratio
    ii) Kern of a circular section

PART B

(Answer one full question from each module, each question carries 14 marks)

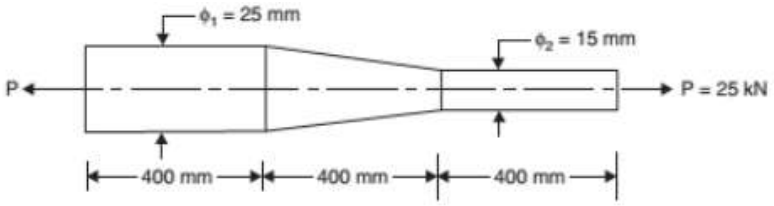
MODULE I

11. A steel bar ABC has the following dimensions:
    Total length – 2400mm; 18 mm diameter for half the length (AB) and 12 mm diameter for the remaining half (BC)
    (i) If the bar is subjected to a tensile force of 22.5kN, Calculate the normal stress and normal strain in the segment AB and BC respectively. (14)

(ii) Also find the total extension of the bar when it is subjected to a tensile force of 22.5kN.
(iii) What would be the extension of a steel bar of uniform diameter having the same length and same volume when subjected to the same tensile force?

OR

12. a) Calculate the total deformationof the bar shown in figure below. What will be the diameter of a bar of uniform cross section, to have the same strain as that of the stepped bar? Take Young's modulus as 2×10^5 N/mm^2. (10)



b) Derive the expression for deflection of a uniformly varying circular section. (4)

MODULE II

13. a) A thin cylinder of internal diameter 2 m contains a fluid at an internal pressure of 3 N/mm^2. Determine the maximum thickness of the cylinder if (8)
i) the longitudinal stress is not to exceed 30 N/mm^2 and
ii) the hoop stress is not to exceed 40 N/mm^2

b) Calculate the strain energy stored in a cantilever beam of length 2 m subjected to a point load 10 kN at the free end. Take E = 200 GPa and I= 1.5×10^7mm^4 (6)

OR

14. a) The maximum instantaneous extension, produced by an unknown falling weight through a height of 4 cm in a vertical bar of length 3 m and of cross sectional area 5 cm^2, is 2.1 mm. Determine (7)
(a) the instantaneous stress induced in the vertical bar, and
(b)the value of unknown weight.
Take E=2×10^5 N/mm^2

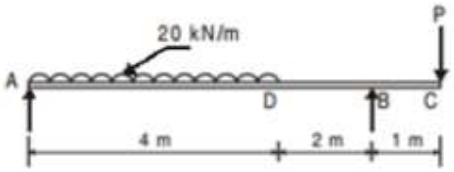
b) Derive the expression E=3K(1-2μ) (7)

15. A beam ABCD 12 m long carries a uniformly distributed load of 25kN/m. It is simply supported at A and C 10 m apart with an overhang CD of 2m. It also carries a clockwise couple of 100 kNm at B, 3 m from A. State the position and amount of maximum BM. Sketch the SFD and BMD (14)

OR

16. Determine the load P such that reactions at supports A and B are equal (14)

in the beam shown in figure given below. Draw the shear force and bending moment diagrams and mark the values at salient points.



MODULE IV

17. A simply supported beam AB of 5m span is carrying a uniformly distributed load of 20kN/m. The beam is made up of rectangular cross section of dimensions 300mm x 450 mm.
i) Draw the bending stress distribution at the critical section for bending.
ii) Draw the shear stress distribution considering the critical section for shear. (14)
iii) Also calculate bending stress and shear stress on layer located 50mm above the neutral axis on the cross section at the mid-point of the beam.

OR

18. a) A beam of I section 200 mm wide and 300 mm deep with flange and webthickness 20 mm is used as a simply supported beam over a span of 7 m. The beam carries a distributed load of 5 kN/m over the whole span and a concentrated load of 20 kN at mid span. Determine the maximum bending stress set up and sketch the stress distribution (10)
b) Draw the shear stress diagram of a rectangular section and mark its salient points (4)

MODULE V

19. a) At a point in a stressed material, the normal stress on a plane is 50 N/mm^2 (T) and a normal stress of 30 N/mm^2 (C) is acting on the plane perpendicular to the given plane. The shear stress acting on these planes is 25 N/mm^2 . Determine the principal stresses and their planes using Mohr's circle. Also determine the maximum shear stress at that point (10)
b) Determine the maximum power transmitted at 280 rpm by a steel shaft of 35 mm internal diameter and 4.5 mm thick, if the allowable stress is 75 MPa and the angle of twist is not to exceed 1˚ in a length of 1.5 m. Assume G= 80 GPa for the material (4)

OR

20. A hollow rectangular cast iron column having outside width and depth 250×500 mm and thickness 20 mm is fixed at one end and hinged at (14)

the other end. Length of the column is 8 m. Calculate the safe load that can be applied on the column assuming a factor of safety of 4. Use Rankine's theory. Take α =1/1600 and σ_c =600 N/mm^2. Compare the value by Euler's theory. Take E= 95 kN/mm^2

****