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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

THIRD SEMESTER B.TECH DEGREE EXAMINATION (Regular), DECEMBER 2022
CIVIL ENGINEERING

(2020 SCHEME)

Course Code: **20CET201**

Course Name: **Mechanics of Solids**

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

Assume any missing data

PART A

(Answer all questions. Each question carries 3 marks)

1. Define Hooke's law.
2. Explain ultimate stress, nominal rupture stress and true rupture stress.
3. Illustrate linear strain and lateral strain with figures.
4. Differentiate proof resilience and modulus of resilience
5. Draw the Shear Force Diagram (SFD) and Bending Moment Diagram (BMD) of a Cantilever beam of length 'L' subjected to point load 'P' at free end.
6. Explain point of contraflexure.
7. Enumerate the assumptions in the theory of simple bending.
8. Sketch the shear stress distribution of a beam of rectangular cross section.
9. Define kern of a section.
10. Enumerate the assumptions made in the derivation of torsion equation.

PART B

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

MODULE I

11. a) Explain the behaviour of mild steel under tensile load. (8)
    b) A steel rod 30 mm diameter and 400 mm long is subjected to axial forces alternating between a maximum compression of 18 kN and a maximum tension of 10kN. Find the difference between greatest and least length of the rod. Take E as 210 GPa. (6)

OR

12. a) A reinforced concrete column of square section with 300 mm sides, has four reinforcement bars of 28 mm diameter one in each corner, with its centre 60 mm from edge as shown in (8)

Figure 1. Find the safe central load on the column if concrete can be stressed to 5 N/mm^2. What is corresponding stress in steel reinforcement and what portion of load is carried by it? Modular ratio, Es:Ec = 18.

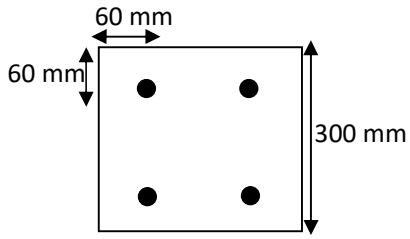

Figure 1

b) A metal rod circular in section tapers from 30 mm diameter to 15 mm diameter in a length of 200 mm. How much will the length increase under an axial pull of 12 kN, if E =100 GPa. (6)

MODULE II

13. a) The modulus of rigidity for a material is 4 x 10^4 N/mm^2. A 10mm diameter rod of the material was subjected to an axial pull of 5kN and the change in diameter was observed as 0.00195mm. Calculate Poisson's ratio and modulus of elasticity of the material. (8)

b) Determine the changes in length, breadth and thickness of a steel bar which is 5 m long, 40 mm wide and 25 mm thick and is subjected to an axial pull of 30 kN in the direction of its length. Take E as 200 GPa and Poisson's ratio as 0.3. (6)

OR

14. a) A steel tube of 40 mm external diameter and 30 mm internal diameter encloses a copper rod of 25 mm diameter in which it is rigidly joined at each end. If, at a temperature of 10ºC, there is no longitudinal stress, calculate the stresses in the rod and the tube when the temperature is raised to 210ºC. E_s = 210 GPa, E_c= 100 GPa, α_s= 11x10^{-6}/ºC, α_c= 18x10^{-6}/ºC. (8)

b) A tensile load of 50 kN is gradually applied to a circular bar of 4 cm diameter and 5 m length. E = 210 GPa. Determine (i) stretch in the bar (ii) stress in rod (iii) strain energy (6)

MODULE III

15. Draw the Shear Force and Bending Moment Diagram of a cantilever beam of length 2 m carrying a UDL of 2kN/m over the whole length and a point load of 5 kN at a distance of 0.5 m from the free end. (14)

OR

16. Draw the Shear Force Diagram and Bending Moment Diagram of the simply supported beam shown in Figure 2. (14)

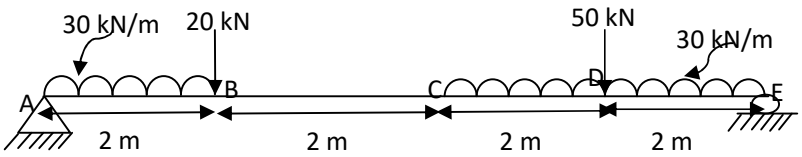

Figure 2

MODULE IV

17. Derive the classic bending equation stating the assumptions (14)

OR

18. a) A beam of symmetrical section with depth 350 mm, moment of inertia 19300 cm^4 is simply supported over a span of 8 m. What UDL may it carry if maximum bending stress is not to exceed 120 N/mm^2. What concentrated load may be carried by beam at the centre with same permissible stress? (8)

b) Determine the strain energy of a cantilever beam of span 3 m having size 20 mm width × 60 mm depth, i) when a concentrated load of 1500 N is placed at free end, ii) when a total of 1500 N load is distributed over the entire length E = 200 GPa. (6)

MODULE V

19. a) A short column of hollow circular section has a projecting bracket carrying a load of 50 kN. The load line is off the axis of the column by 300 mm. The external diameter of column is 300 mm and thickness of metal is 25 mm. Find the maximum and minimum stress. (8)

b) A 250 mm × 125 mm I-section is used with length 5m, one end fixed and other hinged. Using Rankine's constant and factor of safety 3, find the safe axial load. Area of section is 47.55 cm^2, I_x = 5131.6 cm^4, I_y = 334.5 cm^4, f_c is 315 N/mm^2. (6)

OR

20. A shaft running at 3 Hz has to transmit 100 kW. The shaft must not be stressed beyond 60 N/mm^2 and must not twist more than 1º in a length of 2 m. Select a suitable diameter considering strength and serviceability criteria. (14)

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