

Code No: 183CE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech II Year I Semester Examinations, February - 2024

STRENGTH OF MATERIALS – I

(Civil Engineering)

Time: 3 Hours

Max. Marks: 60

Note: This question paper contains two parts A and B.i) **Part- A** for 10 marks, ii) **Part - B** for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of **ten questions** (numbered from 2 to 11) **carrying 10 marks each**. From each unit, there are two questions and the student should answer one of them. Hence, the student should answer five questions from Part-B.

PART- A**(10 Marks)**

- Write the equations used to find the forces in compound bars made of two materials subjected to tension. [1]
- Define proof resilience and modulus of resilience. [1]
- Develop the relation between rate of loading, Shear force and Bending moment. [1]
- A cantilever beam of length 5m is acted upon by moment 120 kNm at the free end. What is the bending moment at fixed end. [1]
- State assumptions made in the theory on bending. [1]
- A beam subjected to a bending stress of 5N/mm^2 and the section modulus is 3000 cm^3 . What is the moment of resistance of the beam? [1]
- Write the differential equation of deflection of a bent beam. [1]
- Give the relation between deflection of bending moment and flexural rigidity for a beam? [1]
- Define Major and minor principal stress theory. [1]
- Explain the term 'stress invariants'. [1]

PART - B**(50 Marks)**

- A reinforced concrete column $500\text{mm} \times 500\text{mm}$ in section is reinforced with 4 steel bars of 25mm diameter, one in each corner, the column is carrying a load of 1500kN. Find the stress in the concrete and steel bars. Take E for steel $= 210 \times 10^3\text{N/mm}^2$ and E for concrete $= 14 \times 10^3\text{N/mm}^2$. [10]

OR

- Find the value of P, the change in length of each component and the total change in length of the bar shown in Figure.1 [10]

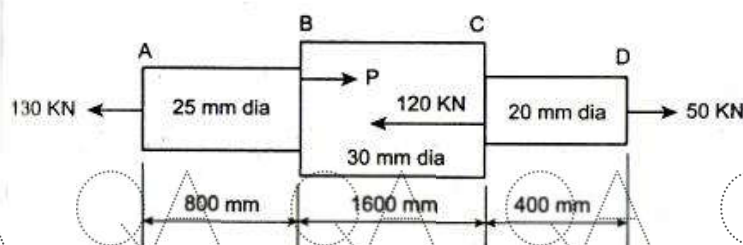


Figure.1

QA QA QA QA QA QA QA QA QA

4. A beam of span 12m is supported at its ends. It is loaded with the gradually varying load of 3kN/m from the left hand support to 6kN/m to the right hand support. In addition, it carries central point load of 15 kN. Construct the SFD and BMD and mark the salient values. [10]

QA QA QA QA QA QA QA QA QA

5. A simply supported beam 10m long rests on supports 8m apart. The right hand end is overhanging by 2m and has load of 5kN. The beam carries a UDL of 20kN/m over the entire length of the beam. Draw SFD and BMD indicating the maximum BM and the point of contra flexure. [10]

QA QA QA QA QA QA QA QA QA

6. A beam of symmetrical section is 350mm deep and has a moment of inertia of $10 \times 10^7 \text{ mm}^4$ about its principal axis. To what radius may it be bent, if the maximum stress is not to exceed 90 N/mm²? Take $E = 2 \times 10^5 \text{ N/mm}^2$. What would be the moment of resistance at this stress? [10]

OR

QA QA QA QA QA QA QA QA QA

7. A timber beam of rectangular section is to support a load of 25 kN uniformly distributed over a span of 5m, when the beam is simply supported. If the depth of the section is to be twice the breadth and the stress in the timber is not exceed 10N/mm², find the breadth and depth of the cross section. How will you modify the cross section of the beam, if it carries a concentrated load of 40 kN placed at the mid-span with the same ratio of breadth to depth. [10]

QA QA QA QA QA QA QA QA QA

8. A beam is simply supported as its ends over a span of 10m and carries two concentrated loads of 100kN and 60kN at a distance of 2m and 5m respectively from the left support. Calculate a) slope at the left support; b) slope and deflection under the loads. Assume $EI = 36 \times 10^4 \text{ kN-m}^2$. [10]

OR

QA QA QA QA QA QA QA QA QA

9. Using conjugate beam method, obtain the slope and deflections at A, B, C and D of the beam shown in Figure.2. Take $E = 200 \text{ GPa}$. [10]

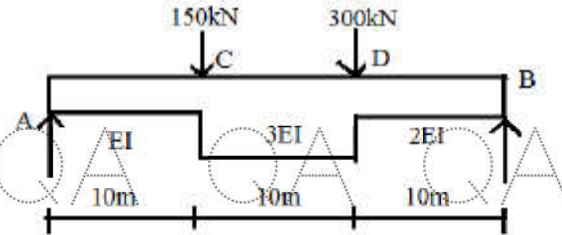


Figure.2

QA QA QA QA QA QA QA QA QA

10. The rectangular stress components of a point in three dimensional stress system are defined as $\sigma_x = 20 \text{ MPa}$, $\sigma_y = -40 \text{ MPa}$, $\sigma_z = 20 \text{ MPa}$, $\tau_{xy} = 40 \text{ MPa}$, $\tau_{yz} = -60 \text{ MPa}$ and $\tau_{zx} = 20 \text{ MPa}$. Examine the principal stresses and principal planes. Also determine associated direction of the state of stress. [10]

OR

QA QA QA QA QA QA QA QA QA

11. A cylindrical shell made of mild steel plate and 1.5m in diameter is to be subjected to an internal pressure of 1.5 MN/m². If the material yields at 200 MN/m², find the thickness of the plate on the basis of (a) maximum principal stress theory (b) maximum shear stress theory (c) maximum shear strain energy theory. [10]