

Strength of Materials (313308)

MSBTE Diploma · K-Scheme · Model Question Paper — Set A

Time: 3 Hours**Max. Marks: 70****Instructions:**

1. All questions are compulsory.
2. Answer each next main question on a new page.
3. Illustrate your answers with neat sketches wherever necessary.
4. Figures to the right indicate full marks.
5. Assume suitable data, if necessary.
6. Mobile phone, pager and any other electronic communication devices are not permissible in the examination hall.

Q.1 Attempt any FIVE of the following:**10**

- a) Define moment of inertia and radius of gyration.
- b) State Hooke's law and define Poisson's ratio.
- c) Define point of contraflexure and point of contra-shear.
- d) State any four assumptions made in the theory of pure bending.
- e) Differentiate between single shear and double shear (any two points).
- f) Define direct load and eccentric load.
- g) State the relation between maximum shear stress and average shear stress for rectangular and circular sections.

Q.2 Attempt any THREE of the following:**12**

- a) State the parallel axis theorem and the perpendicular axis theorem with neat sketches.
- b) Draw the stress–strain diagram for mild steel subjected to a gradually increasing tensile load and explain the important points on it.
- c) A steel rod 25 mm in diameter and 2 m long is subjected to an axial pull of 60 kN. Find the stress, strain, elongation and change in diameter. Take $E = 200$ GPa and Poisson's ratio = 0.3.
- d) A cantilever beam 4 m long carries a uniformly distributed load of 2 kN/m over its entire length and a point load of 8 kN at 3 m from the fixed end. Draw the S.F. and B.M. diagrams.

Q.3 Attempt any THREE of the following:**12**

- a) A hollow circular section has external diameter 160 mm and internal diameter 120 mm. Calculate its moment of inertia about (i) the centroidal axis (ii) a tangent to the outer circle. Also find its polar moment of inertia.

- b) For a material, Young's modulus $E = 2.1 \times 10^5 \text{ N/mm}^2$ and modulus of rigidity $G = 0.8 \times 10^5 \text{ N/mm}^2$. Find Poisson's ratio and bulk modulus.
- c) A simply supported beam of span 6 m carries a u.d.l. of 3 kN/m over 3 m length from the left support and a point load of 8 kN at 4.5 m from the left support. Draw the S.F. and B.M. diagrams and find the maximum bending moment.
- d) A rectangular column 300 mm $\times$ 200 mm carries a load of 240 kN at an eccentricity of 40 mm on the axis bisecting the 200 mm side (i.e. in the plane of the 300 mm side). Find the maximum and minimum stresses and draw the stress distribution diagram.

Q.4 Attempt any THREE of the following:

12

- a) A simply supported beam of rectangular section 120 mm wide and 240 mm deep has a span of 5 m and carries a u.d.l. of 8 kN/m over the entire span. Find the maximum bending stress and the bending stress at 60 mm from the top. Draw the bending stress distribution diagram.
- b) A rectangular beam section 100 mm wide and 200 mm deep is subjected to a shear force of 50 kN. Find the average shear stress, maximum shear stress and shear stress at 50 mm above the neutral axis. Sketch the shear stress distribution.
- c) State Euler's formula and Rankine's formula with the meaning of each term. Give the effective length of a column for different end conditions.
- d) A steel bar ABCD is loaded as shown in Fig. No. 1. Find the total change in length of the bar. Take $E = 200 \text{ GPa}$.

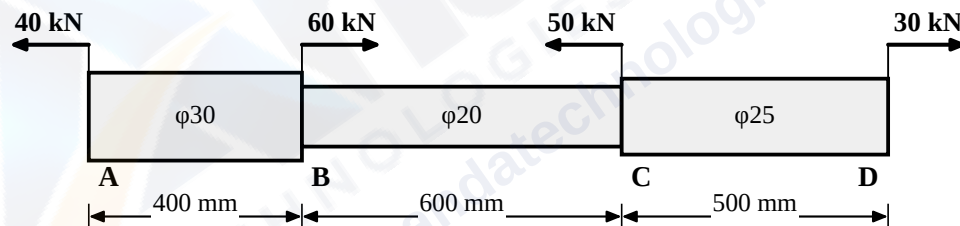


Fig. No. 1

- e) State the condition of no tension for an eccentrically loaded short column. Draw the core of a rectangular section $b \times d$.

Q.5 Attempt any TWO of the following:

12

- a) Draw the S.F. and B.M. diagrams for the overhanging beam shown in Fig. No. 2. Locate the point of contraflexure and find the maximum bending moment.

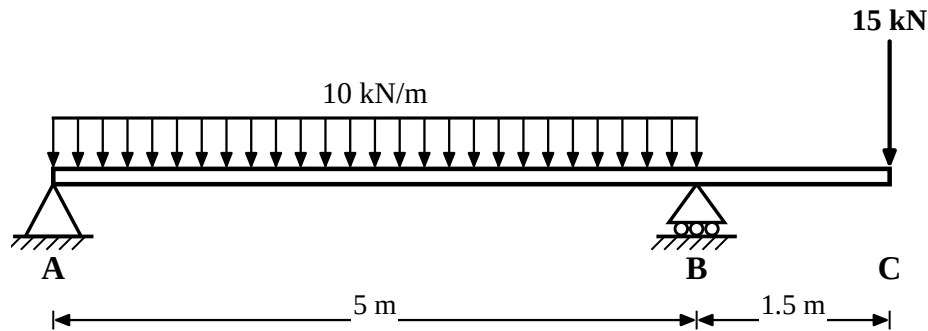


Fig. No. 2

- b) Find the moment of inertia of an unsymmetrical I-section about its centroidal axes X-X and Y-Y: top flange 120 mm × 20 mm, web 200 mm × 15 mm, bottom flange 200 mm × 20 mm (overall depth 240 mm).
- c) A steel rod of 25 mm diameter is placed centrally inside a copper tube of 40 mm external and 30 mm internal diameter. Both are 400 mm long and are fixed together at the ends. The assembly carries an axial pull of 60 kN. Find the stresses in steel and copper, load shared by each and the extension. Take $E_s = 200$ GPa and $E_c = 100$ GPa.

Q.6 Attempt any TWO of the following:

12

- a) A steel cube of 60 mm side is subjected to forces of 12 kN (tensile), 9 kN (compressive) and 6 kN (tensile) along X, Y and Z directions respectively. Find the strain in each direction, the volumetric strain and the change in volume. Take $E = 200$ GPa and Poisson's ratio = 0.3.
- b) A cantilever of rectangular section is 2.5 m long. It carries a u.d.l. of 6 kN/m over its entire length and a point load of 4 kN at the free end. If the permissible bending stress is 10 N/mm² and the depth is twice the width, find the size of the section.
- c) A hollow circular column has external diameter 250 mm and internal diameter 200 mm. It carries a vertical load of 150 kN at an eccentricity of 60 mm from its axis. Find the maximum and minimum stresses at the base and draw the stress distribution diagram. Also find the limit of eccentricity for no tension.

Note: This is a **model question paper prepared by Ananda Technologies** only for practice and exam preparation, based on the pattern of previous MSBTE question papers and the K-scheme syllabus. It is **not an official MSBTE paper**, and it does **not** mean that these questions will come in the exam. Answers follow standard textbook points; marks shown are indicative. Free for students — anandatechnologies.in