

Strength of Materials (313308)

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

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 radius of gyration and state its relation with moment of inertia.
- b) Define modulus of rigidity and bulk modulus.
- c) State the relation between rate of loading, shear force and bending moment.
- d) Draw the bending stress distribution diagram for a T-section used as a simply supported beam.
- e) Define core (kernel) of a section. Sketch the core of a solid circular section of diameter D.
- f) Define proof stress and percentage elongation.
- g) Write the moment of inertia of (i) a triangle about its base and about its centroidal axis parallel to the base (ii) a semicircle about its diameter.

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

- a) State the parallel axis theorem. Using it, find the moment of inertia of a triangle of base 120 mm and height 90 mm about its base.
- b) Define: (i) Ultimate stress (ii) Yield stress (iii) Working stress (iv) Factor of safety.
- c) Find the minimum diameter of a steel wire required to lift a load of 10 kN if the permissible stress is 140 N/mm². If a 10 mm wire is used and its length is 3 m, find its elongation. Take $E = 200 \text{ GPa}$.
- d) A cantilever 2 m long carries a u.d.l. of 1 kN/m over its entire length and point loads of 3 kN at 1 m and 2 kN at 2 m from the fixed end. Draw the S.F. and B.M. diagrams.

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

- a) An unequal angle section 100 mm × 80 mm × 10 mm is placed with its longer leg vertical. Find the moment of inertia about its centroidal axes X–X and Y–Y.

- b) For a material, Young's modulus is $2.05 \times 10^5 \text{ N/mm}^2$ and bulk modulus is $1.6 \times 10^5 \text{ N/mm}^2$. Find Poisson's ratio and modulus of rigidity.
- c) Draw the S.F. and B.M. diagrams for a simply supported beam of span L carrying a u.d.l. of w per unit length over the entire span. Hence find the magnitude and position of the maximum bending moment for a beam of span 8 m carrying 12 kN/m.
- d) A solid circular column of 200 mm diameter carries a vertical load of 80 kN at an eccentricity of 40 mm. Find the maximum and minimum stresses. Will there be tension in the section? Justify.

Q.4 Attempt any THREE of the following:

12

- a) A timber beam 120 mm wide and 200 mm deep is simply supported over a span of 3 m. Find the maximum u.d.l. it can carry if the permissible stresses are 10 N/mm² in bending and 1 N/mm² in shear.
- b) State the shear stress equation for beams with the meaning of each term. Sketch the shear stress distribution diagrams for I-section, T-section and hollow circular section.
- c) Define buckling (crippling) load, effective length and slenderness ratio. State Euler's formula for the crippling load.
- d) A pin of 20 mm diameter connects a fork and an eye (knuckle joint) and carries an axial pull of 40 kN. Find the shear stress in the pin. Explain with a sketch why the pin is in double shear.
- e) A steel cube of 80 mm side is subjected to 20 kN (tensile), 15 kN (compressive) and 10 kN (compressive) along X, Y and Z directions respectively. Find the change in volume. Take $E = 200 \text{ GPa}$ and Poisson's ratio = 0.25.

Q.5 Attempt any TWO of the following:

12

- a) A simply supported beam of span 8 m carries a u.d.l. of 4 kN/m over 4 m from the left support and point loads of 10 kN and 6 kN at 5 m and 6.5 m from the left support. Draw the S.F. and B.M. diagrams. Locate the point of zero shear and find the maximum bending moment.
- b) Find the moment of inertia of a channel section about its centroidal axes X–X and Y–Y: overall depth 200 mm, flanges 80 mm $\times$ 12 mm, web thickness 10 mm.
- c) A steel bar ABCD of uniform cross-sectional area 600 mm² is loaded as shown in Fig. No. 1. Find the net change in length of the bar. Take $E = 200 \text{ GPa}$.

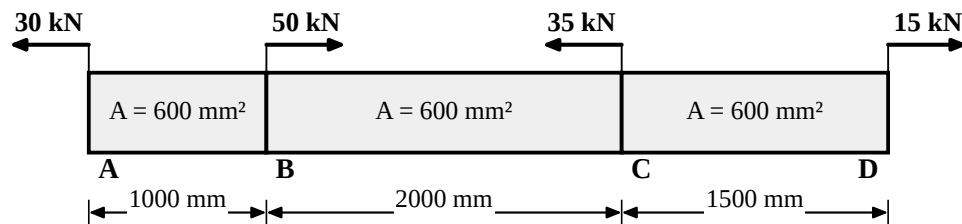


Fig. No. 1

Q.6 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. Find the point of contraflexure.

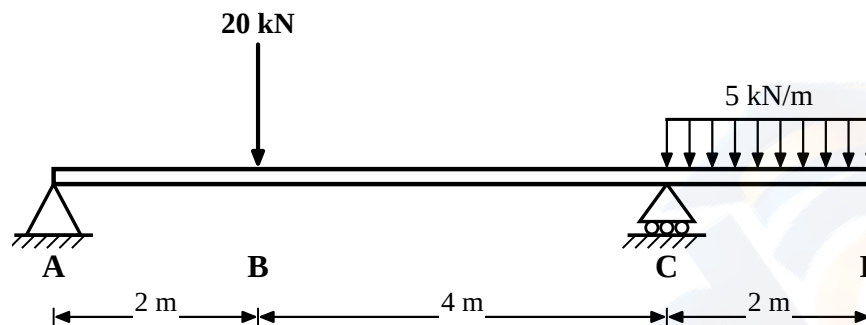


Fig. No. 2

- b) A simply supported beam of rectangular section 100 mm wide and 250 mm deep has a span of 4 m and carries a central point load of 30 kN. Find the maximum bending stress and the maximum shear stress. Draw the bending and shear stress distribution diagrams.
- c) A hollow rectangular column has external dimensions 400 mm $\times$ 300 mm and a uniform thickness of 50 mm. It carries a load of 400 kN at an eccentricity of 60 mm on the axis bisecting the 300 mm side. Find the maximum and minimum stresses and the limit of eccentricity for no tension. Draw the stress distribution diagram.

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