

Strength of Materials (313308)

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

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 section modulus and neutral axis.
- b) State the perpendicular axis theorem.
- c) Define linear strain and lateral strain.
- d) Define shear force and bending moment at a section of a beam.
- e) State the middle third rule.
- f) Define factor of safety and working stress.
- g) Write the expressions for the moment of inertia of (i) a rectangle about its centroidal axis and about its base (ii) a circle about its diameter.

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

- a) Define polar moment of inertia. Calculate the polar moment of inertia of a rectangular lamina 80 mm wide and 120 mm deep about its centroid. Also find its radii of gyration k_{xx} and k_{yy} .
- b) Draw the stress–strain curves for mild steel and Tor steel under tensile loading showing the important points. What is proof stress?
- c) A bar 400 mm long and 20 mm in diameter elongates by 0.25 mm under an axial pull of 40 kN. Calculate the stress, strain and modulus of elasticity of the bar material.
- d) A simply supported beam of span 6 m carries point loads of 10 kN and 15 kN at 2 m and 4.5 m from the left support respectively. Draw the S.F. and B.M. diagrams showing important values.

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

- a) Find the moment of inertia of a T-section about its centroidal axes X–X and Y–Y. Flange 120 mm × 20 mm, web 150 mm × 20 mm (overall depth 170 mm).

- b) A steel cube of 100 mm side is subjected to a compressive force of 1500 kN on each of its six faces. Find the bulk modulus and the change in volume. Take $E = 200 \text{ GPa}$ and Poisson's ratio $= 0.3$.
- c) A hole of 25 mm diameter is to be punched in a steel plate 6 mm thick. The ultimate shear stress of the plate is 300 N/mm^2 . Find the force required to punch the hole and the compressive stress in the punch.
- d) A cantilever 3 m long carries a u.d.l. of 4 kN/m over a length of 2 m from the free end and a point load of 6 kN at the free end. Draw the S.F. and B.M. diagrams.

Q.4 Attempt any THREE of the following:

12

- a) A cantilever of solid circular section is 2 m long and carries a point load of 20 kN at its free end. If the permissible bending stress is 120 N/mm^2 , find the diameter of the section.
- b) A beam of circular section 200 mm in diameter is subjected to a shear force of 150 kN. Find the average and maximum shear stress and sketch the shear stress distribution. Also find the ratio of maximum to average shear stress.
- c) Define effective length and slenderness ratio of a column. Sketch the four end conditions of columns and give the effective length for each.
- d) A steel flat 100 mm wide, 10 mm thick and 3 m long carries an axial tensile load of 120 kN. Find the change in length, width and thickness. Take $E = 200 \text{ GPa}$ and Poisson's ratio $= 0.3$.
- e) Draw the S.F. and B.M. diagrams for a simply supported beam of span L carrying a central point load W . State the maximum S.F. and maximum B.M.

Q.5 Attempt any TWO of the following:

12

- a) Draw the S.F. and B.M. diagrams for the beam shown in Fig. No. 1. Locate the points of contraflexure.

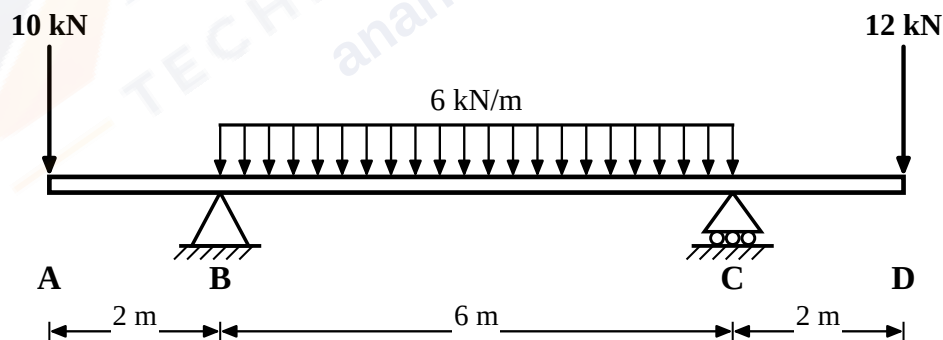


Fig. No. 1

- b) A simply supported beam of span 5 m carries a u.d.l. of 20 kN/m over the whole span. The beam is a symmetrical I-section with flanges $150 \text{ mm} \times 20 \text{ mm}$ and web $260 \text{ mm} \times 10 \text{ mm}$ (overall depth 300 mm). Find the maximum bending

stress and the bending stress at the junction of flange and web. Draw the bending stress distribution diagram.

- c) A steel bar ABCD is loaded as shown in Fig. No. 2. Find the force P for equilibrium, the total elongation of the bar and the minimum stress induced. Take $E = 200 \text{ GPa}$.

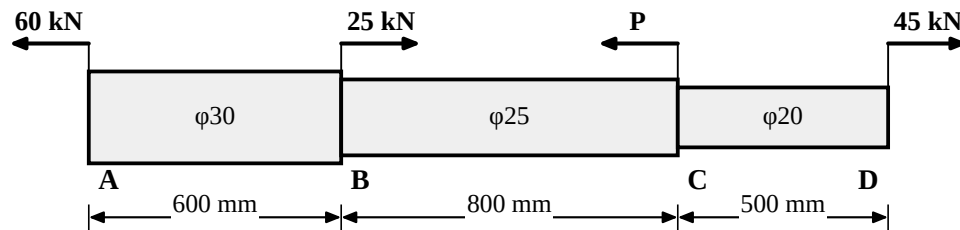


Fig. No. 2

Q.6 Attempt any TWO of the following:

12

- a) A semicircle of 80 mm diameter is cut out from a rectangle 120 mm wide and 160 mm deep as shown in Fig. No. 3. Find the moment of inertia of the remaining section about the base and about its horizontal centroidal axis.

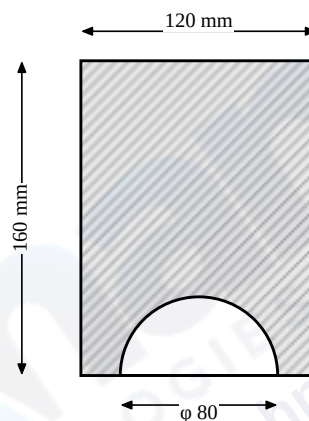


Fig. No. 3

- b) A hollow rectangular beam section has external dimensions 150 mm wide $\times$ 250 mm deep and uniform thickness of 25 mm. It carries a shear force of 80 kN. Draw the shear stress distribution diagram showing important values and find the ratio of maximum to average shear stress.
- c) A rectangular pier 1200 mm $\times$ 800 mm carries a compressive load of 600 kN at an eccentricity of 250 mm on the axis bisecting the 800 mm side. Find the maximum and minimum stresses at the base and draw the stress distribution diagram. What is the maximum 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