1546

April 2025

Time – Three hours
(Maximum Marks: 100)

[*N.B.* Answer all the questions, choosing any two subdivision from each question. Each subdivision carries 10 marks.]

1. (a) A steel wire of 1.5m long and 3.5mm diameter elongated by 0.11mm in length and contracted by 3.5×10^{-5}mm in diameter under tensile load of 200N. Calculate stress, linear strain, lateral strain, Poisson's ratio and Young's modulus.

   (b) A rectangular wooden column of length 4m having cross section of 230mm x 300mm carries an axial load of 400kN. The column is found to be shortened by 2.5mm under the load. Find the stress, strain and Young's modulus.

   (c) Define the following: Young's modulus, modulus of rigidity and bulk modulus. Also write the relationship between them.

   (d) (i) List out the types of forces acting on structural members. (2)
   (ii) Write about any four mechanical properties of materials. (8)

2. (a) Explain the types of supports provided for the beams with neat sketches.

   (b) Construct the SF and BM diagram for the cantilever beam of length 5m loaded with uniformly distributed load (udl) of 5kN/m throughout the length.

   (c) A cantilever of 4m length is fixed at the left end. It carries point loads of 40kN, 30kN and 20kN at 2m, 3m and 4m respectively from fixed end. In addition to point loads, an udl of 10kN/m acts throughout its length. Draw the SFD and BMD for the beam.

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(d) A simply supported beam of span 5m is loaded with udl of 12kN/m throughout the span. Construct the SFD and BMD. Also locate the magnitude of maximum BM.

3. (a) A steel beam of I section has the following details: Top flange = 100mm x 20mm, Bottom flange = 150mm x 12mm, web =150mm x 8mm. Find the centre of gravity of I section.

(b) T section has a flange width of 120mm and thickness of 20mm. The web is 100mm deep and 20mm thick. Locate the centre of gravity and determine I_{XX} and I_{YY}

(c) Calculate the moment of inertia of the I-Section about XX and YY axes having the following details:
Top flange : 150mm x 15mm, Web: 220mm x 15mm,
Bottom flange : 150mm x 15mm.

(d) Write short note on the following: (2+2+3+3)
moment of inertia, polar moment of inertia, parallel axis theorem and perpendicular axis theorem.

4. (a) (i) Write about bending stress. Draw a typical bending stress distribution diagram for a beam. (7)

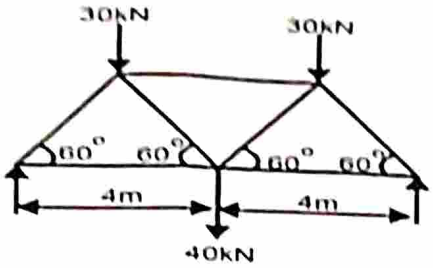
(ii) Write any three assumptions of simple bending theory. (3)

(b) A simply supported beam of 7m span carries a point load of 50kN at its centre. Its cross section is rectangle of size 320mm x 420mm. Determine the maximum bending stress.

(c) A simply supported timber beam is 7m long. It carries an UDL of 18kN/m over the entire span and a point load of 12kN at mid span. The stress in beam is not to exceed $7.5N/mm^2$. Design a suitable section by assuming depth as twice the width.

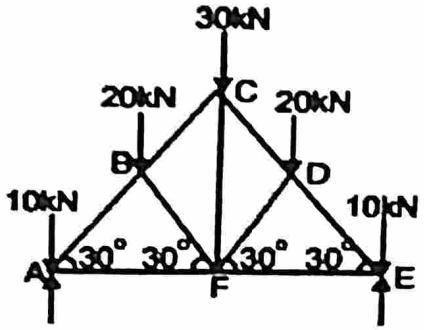
(d) A steel wire of 8 mm diameter is bent into a circular shape of 6 m radius. Determine the maximum stress induced in the wire. Take $E=2\times10^5 N/mm^2$.

5. (a) Determine the magnitude and nature of forces in the members of truss shown in figure by method of joints.



(b) Write about the following: (3+2+5)
Method of sections, rafters and classification of frames.

(c) Determine the magnitude and nature of forces in the members of truss shown in figure by method of joints.



(d) Determine the magnitude and nature of forces in the members of truss shown in figure by method of joints.