B.Tech Odd Semester (CBCS) Exam., December—2017

AGRICULTURAL ENGINEERING

(3rd Semester)

Course No. : AE–303 (C)

(Strength of Materials)

Full Marks : 75
Pass Marks : 30

Time : 3 hours

Note : 1. Answer **one** question from each Unit.
2. Begin each answer in a new page.
3. Answer parts of a question at a place.
4. Assume reasonable data wherever required.
5. The figures in the margin indicate full marks for the questions.

UNIT—1

1. *(a)* Distinguish between force and stress. A brass bar of varying sections is subjected to the loads shown in Fig. 1. Find the maximum stress and the total elongation if E 100 GPa : 10

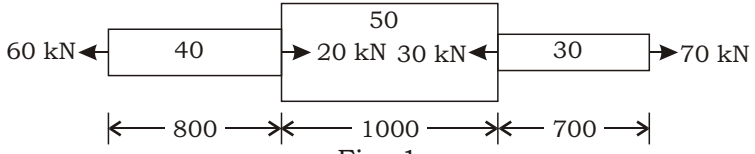

Fig. 1

(b) What is the difference between deformation and strain? A steel rod of diameter 20 mm and length 400 mm is covered by a rigidly connected brass shell of inside diameter 20 mm and outside diameter 40 mm. Find the stresses in two materials and the deformation when the composite structure is subjected to a load of 100 kN. E 200 GPa for steel and 100 GPa for brass. 5

2. *(a)* Define the following : 10

Modulus of elasticity, Poisson's ratio, modulus of rigidity, specific weight, shear strain

(b) A solid circular steel bar of 20 mm diameter is subjected to an axial load of 60 kN. What is decrease in the diameter of the bar?

[Take, E 200 GPa and υ 0·3.] 5

UNIT—2

3. *(a)* What is the difference between centroid and centre of gravity? Determine the

centroid (x_c, y_c) of I-section of uniform thickness shown in Fig. 2 : 10

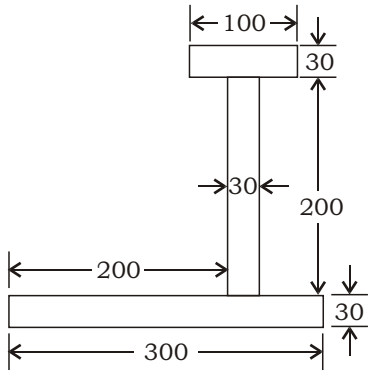

Fig. 2

(b) Write the applications of moment of inertia. Determine the moment of inertia of the I-section shown in Fig. 2 about its base. 5

4. *(a)* What are the applications of SFD and BMD? Draw SFD and BMD for a simply supported beam with span of 8 m carrying a symmetric triangular load with maximum load of 100 kN/m at the mid-span. 10

(b) What is point of contraflexure? A double overhanging beam with span of 8 m and overhang of 2 m on each side has a concentrated load of 500 kN at the mid-span. Draw SFD and BMD for this beam. 5

UNIT—3

5. *(a)* What is pure bending? State flexure formula. Write the meaning of each term. 5

(b) What is neutral axis? A simply supported beam of 10 m length is subjected to a concentrated load of 500 kN at its mid-span. The beam has channel section of uniform thickness with dimensions as shown in Fig. 3. Determine the maximum compressive and tensile stresses acting on the beam section : 10

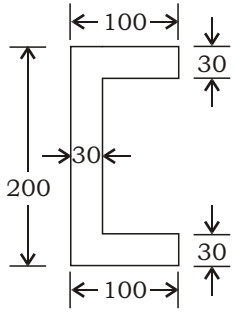

Fig. 3

6. *(a)* Write the equation used for the determination of shear stress distribution in the cross-section of a beam subjected to bending. A simply supported beam of I-section of uniform thickness shown in Fig. 4 has the

span of 8 m. It supports a concentrated load of 100 kN at its mid-span. Draw a shear stress distribution diagram and find the maximum shear stress : 10

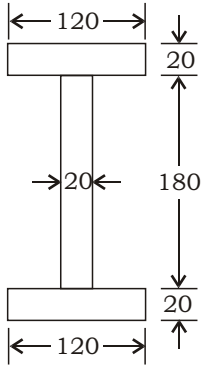

Fig. 4

(b) For a beam of rectangular cross-section subjected to load, show that the maximum shear stress induced due to bending in the cross-section is 1·5 times the average shear stress. 5

UNIT—4

7. *(a)* What are slope and deflection? A simply supported beam carries a uniformly distributed load over the whole span. Find the maximum slope and deflection and their locations on the beam. Sketch the elastic curve. 10

(b) A simply supported beam of span 5 m carries a uniformly distributed load of 40 kN/m over its entire span. Determine the slope at the supports and the maximum deflection.

[Take, E 200 GPa and I 56000 cm^4.] 5

8. What is the use of Macaulay's method? An overhanging beam of span 8 m between the supports and one side overhand length of 2 m carries a uniformly distributed load of 40 kN/m over the whole length. Find the slope at the supports, deflection at the free end and maximum deflection. 15

UNIT—5

9. *(a)* What is torque? Write the torsion formula along with meaning of each term. What is the difference between shear stress induced due to torsion and shear stress induced due to bending? 5

(b) A shaft has to transmit power of 5 MW at 1000 rpm. The maximum shear stress is not to exceed 100 MPa and the angle of twist is not to exceed 1° per meter length. Design the shaft if it is a *(i)* solid circular shaft and *(ii)* hollow circular shaft of internal diameter 90% of the external diameter. Also, find saving in material.

[Take, G 80 GPa.] 10

10. What is principal stress? An element in a structure is subjected to a plane stress system has the stress values $_x$ 120 N/mm^2 tension, $_y$ 160 N/mm^2 compression and $_{xy}$ 60 N/mm^2. Draw Mohr's circle and find *(a)* principal stresses and locations of principal planes, and *(b)* the maximum shear stress, the accompanying normal stress and directions of planes. Verify your answers analytically as well. 15

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