B.Tech Even Semester Examination, May, 2025

Agricultural Engineering
(4th Semester)

Course No: AE-401
(Strength of Materials)

Full Marks: 50
Pass Marks: 25
Time: 2 hours

Note:
1. Attempt any five questions.
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 figure in the right margin indicates full marks for the question
6. All the mathematical symbols and abbreviations have their usual meanings.

1. (a) (i) Write the formulae to find moment of Inertia of hollow circular section about its xx and yy centroidal axes.

   (ii) Differentiate between single shear and double shear.

   (iii) Define brittleness. Enlist any two names of brittle materials.

   (iv) Define point of contraflexure. [1.5X4=6]

   (b) The maximum stress produced by a pull in a bar of length 1mis 150N / mm^2. The area of cross-sections and length are shown in Fig.6. Calculate the strain stored in the bar if E = 2 x10^5 N / mm^2 [4]

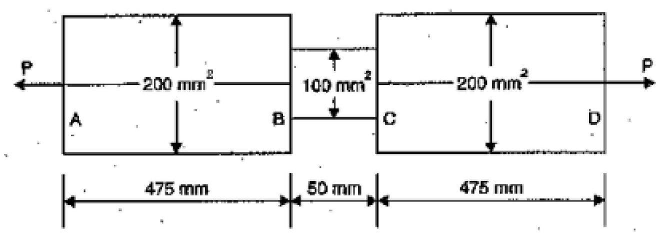

Fig. No-1

2. (a) Two brass rods and one steel rod together support a load as shown in Fig.2. If the stresses in brass and steel are not to exceed 60 N/mm² and 120 N/mm², find the safe load that can be supported. Take E for steel = 2 x10^5 N/mm²,and for brass = 1x10^5 N/mm², . The cross-sectional area of steel rod is 1500 mm² and of each brass rod is 1000 mm². [5]

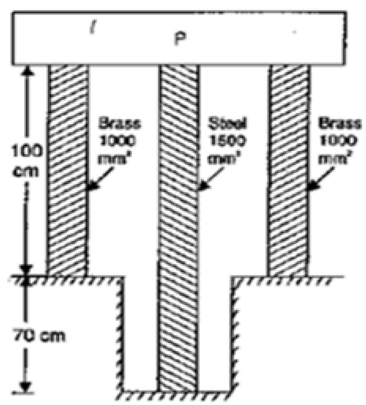

Fig. No-2

(b) A simply supported beam of length 6 m, carries point load of 3 kN and 6 kN at distances of 2 m and 4 m from the left end. Draw the shear force and bending moment diagrams for the beam. [5]

surface shear stress and relative angle of twist along the length of the shaft. What is the maximum shear stress and the angle of twist between the ends of the shaft? Take G= 80 x 109 N/m2. Assume the shaft is sufficiently supported on a number of bearings so that bending may be neglected. [10]

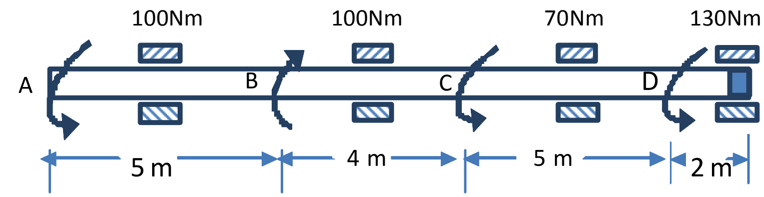

Fig. No-5

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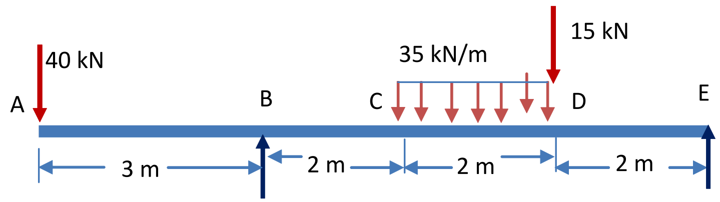

Fig No-4

6. (a) A hollow rectangular beam section square in size having outer dimensions 120 mm × 120 mm with uniform thickness of material 20 mm is carrying a shear force of 125 kN. Calculate the maximum shear stress induced in the section. [7]

(b) Define section modulus and neutral axis. [3]

7. (a) Show that the resultant force for a rectangular section for half section above the neutral axis is 3M/2d where M is the bending moment at a cross-section and d is the depth of section. Also find the position of section where this resultant force passes. [5]

(b) A cylindrical bar is 30 mm in diameter and 2000 mm long. The bar is subjected to uniform stress of 100 N/mm^2 in all directions. Calculate the modulus of rigidity and bulk modulus. If the modulus of elasticity is 1×10^5 N/mm^2 and Poisson's ratio is 0.2. [5]

8. For the line shaft running at 200 rpm and 5 cm diameter throughout its length as shown in Fig.4, a torque of 200 Nm is applied at B. Torques taken off from the shaft to various machines from section A, C and d are 100 Nm, 20 Nm and 80 Nm respectively. Show variation of torque,

3. (a) A beam is as shown in Figure No. 3. Draw S.F. and B.M. diagrams and locate the point of contraflexure. [5]

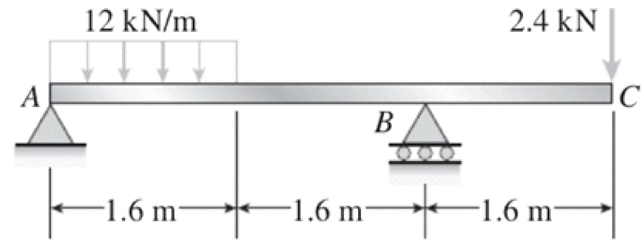

Fig. No.-3

(b) A steel rail is 12.6m long and is laid at a temperature of 24°C. The maximum temperature expected is 44°C. Determine:

(i) The minimum gap between two rails to be left so that temperature stresses do not develop.

(ii) Thermal stresses developed in the rails if no expansion joint is provided. Take $E=2\times10^5$ N/mm^2 and $\alpha = 12 \times10^{-6}/°C$. [5]

4. A steel bar 800mm long and 40 mm is diameter is subjected to an axial tensile load of 100kN. If the modulus of elasticity is 200GPa and poisson's ratio 0.3. Calculate:

(i) Change in diameter and length;

(ii) Principal stresses and volumetric stress:;

(iii) Principal strains;

(iv) Bulk modulus and modulus of rigidity;

(v) Volumetric strain and change in volume.[10]

5. For the loading shown in Fig.4 on a simply supported beam with overhang, draw S.F. and B.M. diagrams. All loads are in kN and distances in m. [5+5]