[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
(2123)

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B. Tech 1st Semester Examination

Engineering Mechanics (N.S.)

BE-105

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : This question paper carries five sections. Attempt any five questions selecting atleast one question each from section A, B, C & D. Section E is compulsory.

SECTION - A

1. (a) Determine the C.G. of the area shown by section lines in the diagram shown in Fig. 1 below. **(10)**

   (b) Determine the moment of inertia of the cross-section of an iron beam as shown in Fig. 2 below with respect to the centroidal axis parallel to the base AB. **(10)**

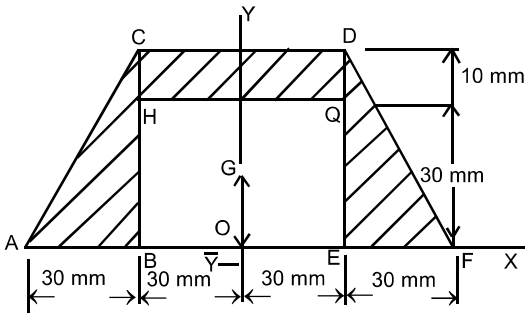

Fig. 1

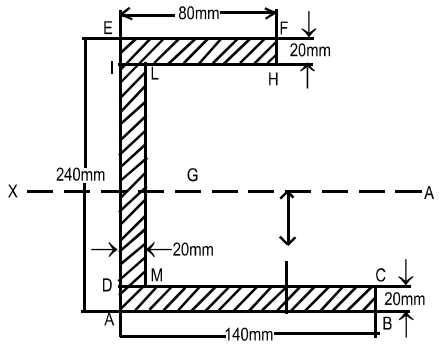

Fig. 2

2. (a) What do you mean by: (i) Perfect Frame, (ii) a deficient frame, and (iii) a redundant frame? **(6)**

(b) Analyse the truss shown in Fig. 3. All members are 3 m long. **(14)**

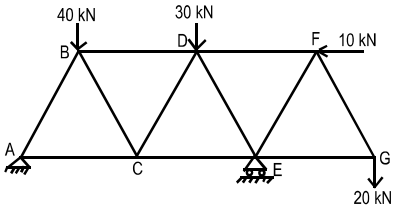

Fig. 3

SECTION - B

3. (a) Derive the relationship between Modulus of Elasticity & Modulus of Rigidity? **(6)**

(b) A rectangular bar of cross section 30 mmx 60 mm and length 200 mm is restrained from expansion along its 30 mm x 200 mm sides by surrounding material. Find the change in dimension and volume when a compressive force of 180 kN acts in axial direction (Ref. Fig. 4). Take $E=2xl0^5$ N/mm^2 and μ=0.3. What are the changes if surrounding material can restrain only 50% of expansion on 30 mmx200 mm side? **(14)**

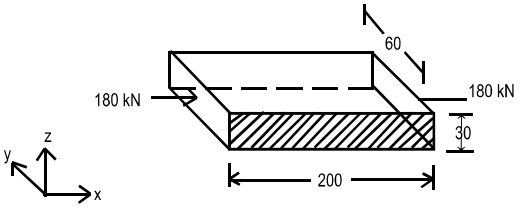

Fig. 4

4. A simply supported beam carries distributed load varying uniformly from 125 N/m at one end to 250 N/m at the other. Length of the beam is 9 m. Draw the shear force (S.F.) and bending moment (B.M.) diagrams and determine the max. B.M. (Ref. Fig. 5). **(20)**

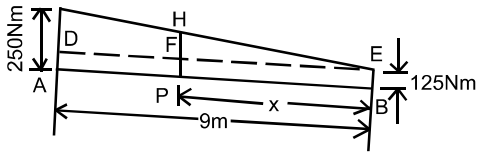

Fig. 5

SECTION - C

5. (a) Write short note on practical application of bending equation. Also define section modulus. **(6)**

(b) The cross-section of conveyor beam is as shown in Fig. 6. The beam is subjected to a bending moment in the plane YY.

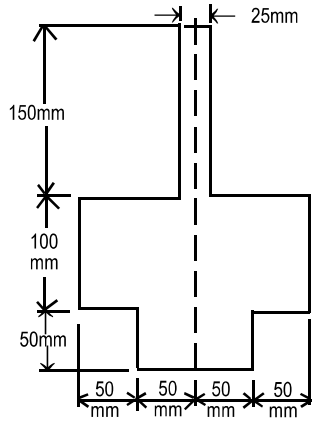

Fig. 6

Determine the maximum permissible bending moment (a) for bottom flange in tension (b) for bottom flange in compression. Safe bending stresses in tension and compression are 300 N/mm^2 and 150 N/mm^2 respectively. **(14)**

6. (a) Derive the expression for shear stress distribution for rectangular beam section. **(6)**

(b) A simply supported beam carries a uniformly distributed load of intensity 30 N/mm over the entire span of 1 metre. The cross-section of the beam is a T-section having the dimension as shown in Fig. 7. Calculate the maximum shear stress for the section of the beam. **(14)**

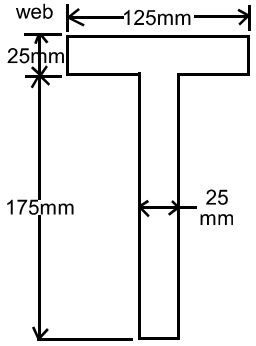

Fig. 7

[P.T.O.]

SECTION - D

7. (a) Write down the assumptions made in the theory of pure torsion. Also define polar modulus. **(6)**

   (b) A solid steel shaft has to transmit 75 kW at 200 r.p.m. Taking allowable shear stress as 70 N/mm^2, find the suitable diameter of the shaft, if the maximum torque transmitted in each revolution exceeds the mean by 30%. Also find the outer diameter of a hollow shaft to replace the solid shaft if the diameter ratio is 0.7. **(14)**

8. (a) Explain the following: (i) Angle of Friction, (ii) Angle of Repose and (iii) Cone of friction. **(6)**

   (b) Two planes AC and BC inclined at 60° and 30° to the horizontal meet at C as shown in Fig.8. A block of weight 1000N rests on the inclined plane BC and is tied by a rope passing over a pulley to a block weighing W newtons and resting on the planes AC. If the coefficient of friction between the block and plane BC is 0.28 and that between the block and the plane AC is 0.20, find the least and the greatest value of W for the equilibrium of the system. **(14)**

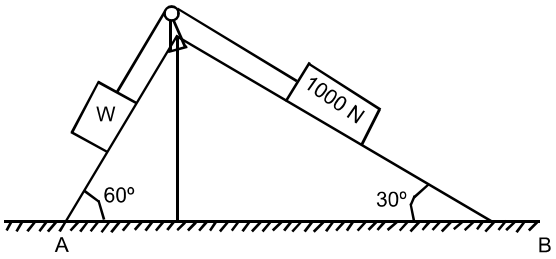

Fig. 8

SECTION - E
(Compulsory Question)

9. Write short answers of the following:
   (a) What is a centroid? Explain the physical significance of centroid of an area.
   (b) State theorems of parallel and perpendicular axis to find Moment of Inertia.
   (c) Explain graphical method of analysis of frame.
   (d) Explain point of contraflexure in case of beam.
   (e) Define Nominal Stress and True Stress.
   (f) Explain the theory of simple bending.
   (g) Explain the shear stress distribution for solid circular section.
   (h) Explain the theory of pure torsion.
   (i) Derive the expression for power transmitted by a shaft.
   (j) Explain the following: (i) Limiting Friction and (ii) Laws of friction.

(2x10=20)