



RN-6147

**B. E. - II (Sem. III) (Civil) Examination**  
**May / June - 2010**  
**Mechanics of Solids**

Time : 3 Hours]

[Total Marks : 100

**Instructions :**

(1)

नीचे दर्शाविएल निशानीवाणी विगतो उत्तरवडी पर अवश्य वपनी.  
Fillup strictly the details of signs on your answer book.

Name of the Examination :  
**B. E. - 2 (Sem. 3) (Civil)**

Name of the Subject :  
**Mechanics of Solids**

Subject Code No. : **6 1 4 7** Section No. (1, 2,.....) : **1&2**

Seat No. : 

--	--	--	--	--	--

Student's Signature

- (2) Write **two** sections in **separate** answer books.
- (3) Figures to the right indicate full marks.
- (4) Assume suitable data if necessary and mention them clearly.
- (5) Programmable calculator is not allowed.

**SECTION - I**

- 1 Answer the following : 10
- (i) Relation between E (Young's Modulus) and C (Modulus of rigidity) is given by \_\_\_\_\_.
    - (a)  $E = 3G (1 + \mu)$
    - (b)  $E = 2G (1 + \mu)$
    - (c)  $E = 2G / (1 + \mu)$
  - (ii) The bending equation is given by \_\_\_\_\_.
  - (iii) The Poisson's ratio is the ratio of linear strain to lateral strain.
    - (a) True
    - (b) False
  - (iv) Torque required for unit angle of twist is known as \_\_\_\_\_.
    - (a) Torsional stiffness
    - (b) Torsional rigidity
    - (c) Polar modulus
  - (v) The bending moment on a section is \_\_\_\_\_ where shear force is zero.
    - (a) Minimum
    - (b) Zero
    - (c) Maximum

- (vi) The maximum shear stress developed in a beam of circular section is \_\_\_\_\_ the average shear stress.  
(a)  $3/2$  (b)  $4/3$   
(c) Equal
- (vii) Factor of safety is the ratio of ultimate stress to \_\_\_\_\_.  
(a) Yield stress (b) Working stress  
(c) None of above
- (viii) At the neutral axis of a rectangular beam, the shear stress is \_\_\_\_\_.  
(a) Zero (b) Maximum  
(c) Minimum
- (ix) The extension of tapered circular bar is given by \_\_\_\_\_.
- (x) Define modular ratio.

2 Draw shear force and bending moment diagram for the beam shown in figure 1. 10

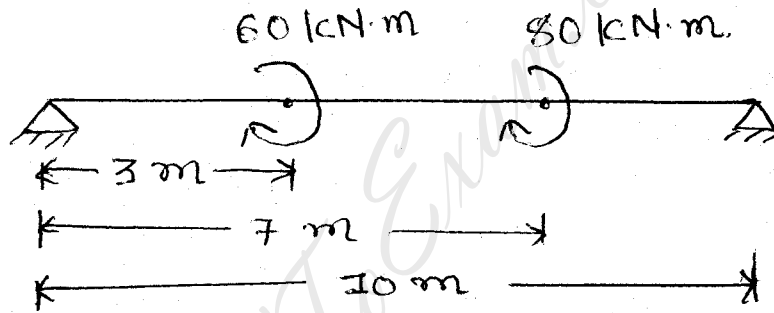


Fig. 1

3 Attempt any three : 30

- (i) The circular bar of 500 mm length has a cross section area as shown in figure 2. Determine the maximum axial pull which the bar may be subjected if the maximum stress is limited to  $100 \text{ N/mm}^2$ . Also find the total elongation. Take  $E = 2 \times 10^5 \text{ N/mm}^2$ .

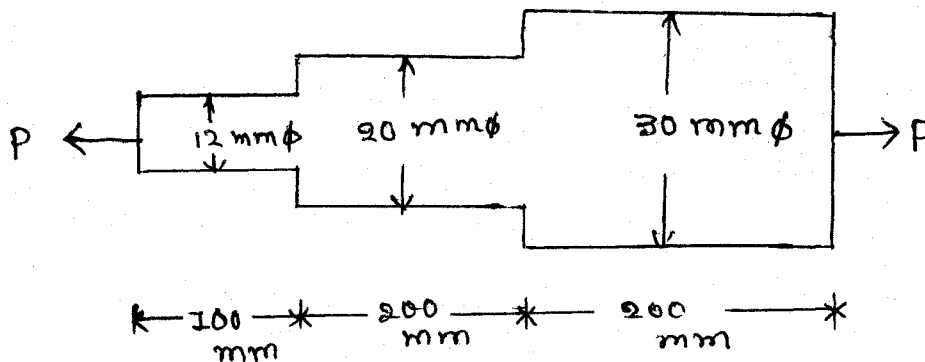


Fig. 2

- (ii) A simply supported beam of 6 m span is subjected to uniformly distributed load of 15 kN/m throughout the span. The cross section of beam is rectangular as shown in figure 3. Find the maximum bending stress in the cross section of beam. Calculate the bending stress at a section 2 m from left hand portion.

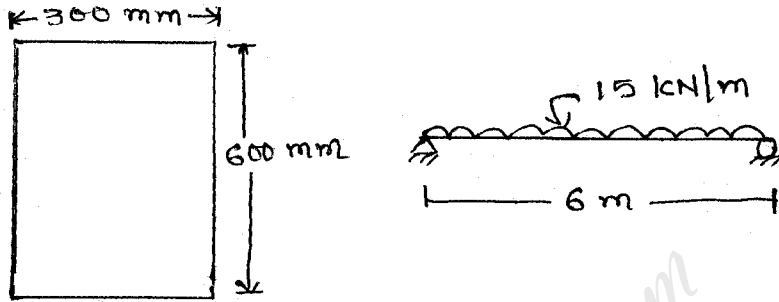


Fig. 3

- (iii) Figure 4 shows the cross section of a beam which is subjected to a vertical shearing force of 12 kN. Find the ratio of maximum shear stress to the mean shear stress.

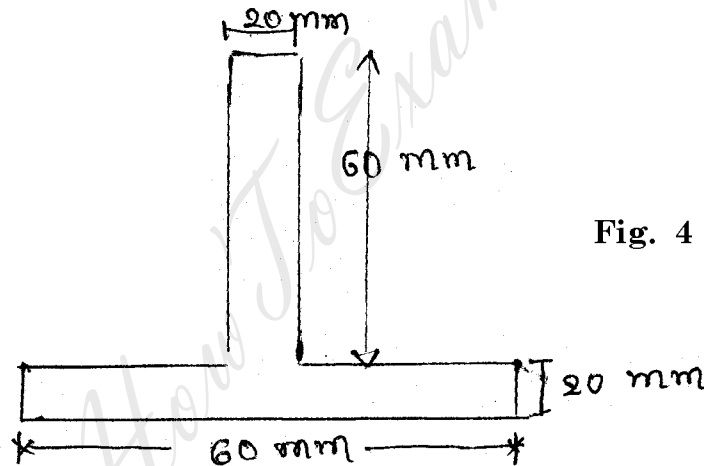


Fig. 4

- (iv) Derive the torsional equation.

$$\frac{T}{J} = \frac{q}{r} = \frac{G\theta}{L}$$

## SECTION - II

- 4 Use suitable words/expressions to complete the following : 10
- (i) The max. strain energy which can be stored in a body without exceeding the elastic limit is called \_\_\_\_\_.
  - (ii) Effective length of a chimney of height 22 m is \_\_\_\_\_ m.
  - (iii) The hoop stress and radial stress \_\_\_\_\_ across the wall thickness of thick shell. (Remain constant/vary linearly/vary non linearly)

- (iv) Euler's formula for buckling load calculation is suitable for \_\_\_\_\_ columns.
- (v) According to I.S. code for tension test of metals the gauge length of specimen should be \_\_\_\_\_  $\sqrt{A_o}$ .
- (vi) The materials which have the same elastic properties in all direction are called \_\_\_\_\_ materials.
- (vii) If the wall thickness of a shell is greater than \_\_\_\_\_ times the mean diameter it is called thick shell.
- (viii) The maximum shear stress is equal to \_\_\_\_\_ of Mohr's circle.
- (ix) To estimate the ductility \_\_\_\_\_ test is suitable.
- (x) In Lamé's equation for thick cylinder there are \_\_\_\_\_ arbitrary constants.

**5** Attempt any **two** : **20**

- (i) A cast iron column of hollow circular section is 5 m long with both ends firmly built in. It safely carries an axial load of 800 kN. Determine the section of the column using factor of safety 3. Assume internal diameter of the column as 80% of external diameter. Use Rankine's formula. Take  $f_c = 550$  MPa and  $\alpha = \frac{1}{6400}$ .
- (ii) An unknown weight falls through a height of 10 mm on a collar rigidly attached to the lower end of a vertical bar 5 m long and  $600 \text{ mm}^2$  in section. If the maximum extension of the rod is to be 2 mm what is the corresponding stress and magnitude of the unknown weight? Take  $E = 200 \text{ GN/m}^2$ .
- (iii) A solid steel post of 3m length and  $250 \text{ mm} \times 450 \text{ mm}$  cross-section is fixed at its bottom in the ground and its top is open. If a heavy wt. of 100 kg suddenly falls on the top of the post from a clear height of 500 mm due to breaking of chain from a crane, find out the maximum instantaneous compression of the post. Take  $E = 2 \times 10^5 \text{ N/mm}^2$ .

**6** Attempt any **two** : **20**

- (i) A cylindrical shell is 3m long, 1.5 m internal diameter and 20 mm metal thickness. Calculate the change in volume if it is subjected to an internal pressure of  $2 \text{ N/mm}^2$ .  
Take  $E = 2 \times 10^5 \text{ N/mm}^2$  and  $\frac{1}{m} = 0.3$ .
- (ii) A strained element is subjected to a stress of  $105 \text{ MN/m}^2$  (tensile) and  $35 \text{ MN/m}^2$  (compressive) along with a shear stress of  $70 \text{ MN/m}^2$ . Find principal stresses and direction of principal planes. Also calculate max. shear stress.
- (iii) (a) Write short notes on Impact Test of metals.  
(b) Draw stress-strain curve of mild steel in tension and show important points on it.