MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : CE-301

SOLID MECHANICS

Time Allotted: 3 Hours

Full Marks: 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words
as far as practicable.

Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for *any ten* of the following: http://www.makaut.com 1×10=10

   (i) The property of a material by virtue of which it can be drawn into thin wire is

   (a) Brittleness   (b) Ductility

   (c) Elasticity   (d) None of these

   (ii) When a body is subjected to bi-axial stress i.e. direct stresses (σ_x) and (σ_y) in two mutually perpendicular planes accompanied by a simple shear stress (τ_{xy}), then maximum shear stress is

   (a) $\frac{1}{2}\sqrt{(\sigma_x - \sigma_y)^2 + 4(\tau_{xy})^2}$ (b) $\frac{1}{2}\sqrt{(\sigma_x + \sigma_y)^2 + 4(\tau_{xy})^2}$

   (c) $\sqrt{(\sigma_x - \sigma_y)^2 + (\tau_{xy})^2}$ (d) $\sqrt{(\sigma_x + \sigma_y)^2 + (\tau_{xy})^2}$

   (iii) A body is subjected to a direct tensile stress of 300 MPa in one plane accompanied by a simple shear stress of 200 MPa. The minimum normal stress will be http://www.makaut.com

   (a) –100 MPa   (b) 250 MPa

   (c) 300 MPa   (d) 400 MPa

   (iv) For a uniaxial loaded bar if the bar is hanging by its self-weight only then the deflection will be

   (a) WL/2AE   (b) WL/AE

   (c) 2WL/AE   (d) more than 1 m

Group – B

(Short Answer Type Questions)

Answer *any three* of the following.

5×3=15

2. Draw shear force and bending moment diagram for the beam shown in Figure 1.
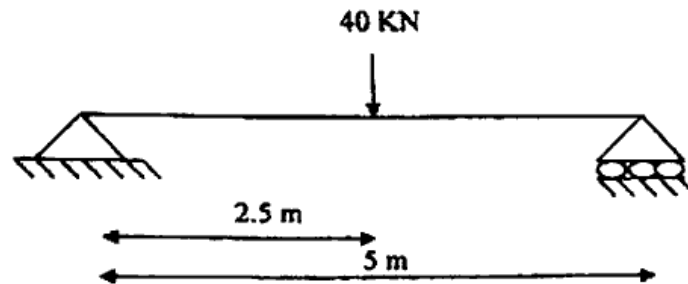
40 KN

2.5 m

5 m

Figure 1

3. A beam of circular cross-section of diameter 'd' is simply supported over a span of 8 m. A vertical load of 2 KN is applied at a distance of 3 m from the right support. Determine the diameter of the section if the allowable bending stress developed in the beam is 90 Mpa. http://www.makaut.com

4. A steel bar of varying cross-section is subjected to loads as shown in Figure 2. Calculate total elongation of the bar. $E = 2 \times 10^5$ Mpa.

(30mm×30mm) (20mm×20mm) (25mm×25mm)

120 KN **220 KN**
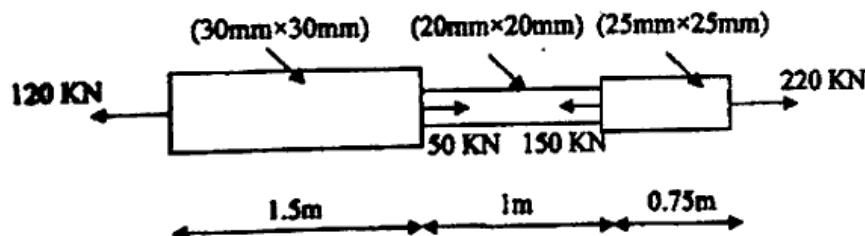
50 KN 150 KN

1.5m 1m 0.75m

Figure 2

5. Find out the expression for maximum deflection and slope at the supports for a simply supported beam loaded with a point load 'W' at the mid-span. http://www.makaut.com

6. Find axial forces in the member AE, EC, ED, AD, DC and BD of the truss shown in Figure 3.
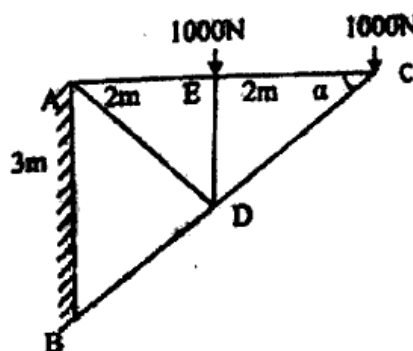
1000N 1000N

A 2m E 2m α C

3m

D

B

Figure 3

(v) By using Mohr' Circle we can find out

(a) Major principal axis

(b) Major and Minor principle stress

(c) Principle stresses and Max shear stress

(d) Maximum and Minimum shear stress

(vi) Principle planes are those planes where there is normal stress but

(a) no shear stress. http://www.makaut.com

(b) shear stress minimum.

(c) shear stress maximum.

(d) None of these

(vii) In a stressed body only 's' is only normal stress, then what will be the value of Maximum shear stress?

(a) s

(b) s/2

(c) 0

(d) 2s

(viii) Strain is defined as the ratio of

(a) change in volume to original volume.

(b) change in length to original length.

(c) change in cross-sectional area to original cross-sectional area.

(d) Any one of the above

(ix) Deformation per unit length in the direction of force is known as

(a) strain

(b) lateral strain

(c) linear strain

(d) linear stress

(x) A thin mild steel wire is loaded by adding loads in equal increments till it breaks. The extensions noted with increasing loads will behave as under — http://www.makaut.com

(a) Uniform throughout

(b) Increase uniformly

(c) First increase and then decrease

(d) Increase uniformly first and then increase rapidly

(xi) If the radius of wire stretched by a load is doubled, then its Young's modulus will be

(a) doubled.

(b) become four times.

(c) become on-fourth.

(d) remain unaffected.

(xii) The intensity of stress which causes unit strain is called

(a) unit stress   http://www.makaut.com

(b) bulk modulus

(c) modulus of rigidity

(d) modulus of elasticity

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Group – C
(Long Answer Type Questions)
Answer *any three* of the following. $15 \times 3 = 45$

7. Draw S.F. and B.M. diagrams for the beam shown in Figure 4. Determine the value of maximum B.M. and locate point of contra-flexure. http://www.makaut.com
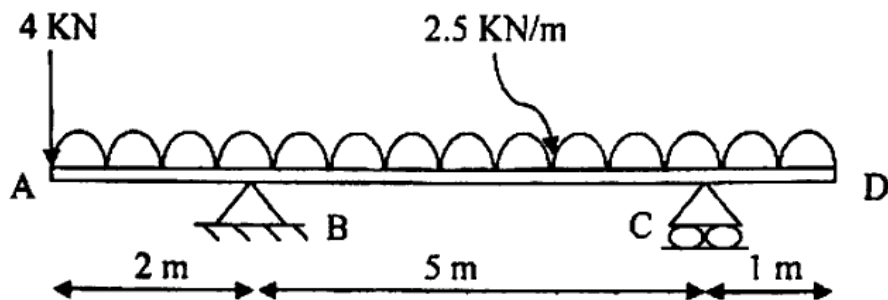

Figure 4

8. (a) A rectangular block is subjected to a tensile stress of 110 Mpa on one plane and a tensile stress of 47 Mpa on a plane right angle to it. A shear stress of 63 Mpa is acting on the same planes as shown in Figure 5. Calculate direction of principal planes, magnitude of principal stresses, magnitude of maximum shear stress and direction of planes of maximum shear stress showing a clear diagram.
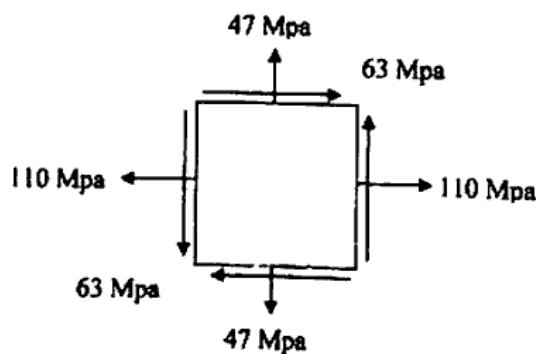

Figure 5

(b) A solid circular shaft transmits 75 kW at 200 r.p.m. Calculate the shaft diameter if angle of twist in the shaft is not to exceed $1°$ in 2 m length of the shaft. Shearing stress is limited to 50 Mpa. Modulus of rigidity = 10^5 Mpa. http://www.makaut.com

$9+6=15$

9. (a) Write down the Assumptions of Euler's formula used in Long column.

(b) A hollow alloy tube 5 m long with external and internal diameters 40 mm and 25 mm respectively was found to extend 6·4 mm under a tensile load of 60 KN. Find the buckling load for the tube when used as a column with both ends pinned. Also find the safe load for the tube, taking factor of safety = 4.

$5+10=15$

10. (a) A circular pipe of external diameter 100 mm and internal diameter 80 mm is the cross-section of a simply supported beam of length 5 m. Find safe concentrated load the beam can carry at mid span if allowable bending stress is 120 Mpa and allowable shear stress is 40 Mpa.

(b) A steel plate (15 mm × 50 mm) is tested by a tensile load of 45 KN. The line of action of the load is 35 mm above base. An extension of 0·055 mm is found over a length of 125 mm. Determine Young's modulus of steel and extreme stresses for the plate section. http://www.makaut.com   7+8=15
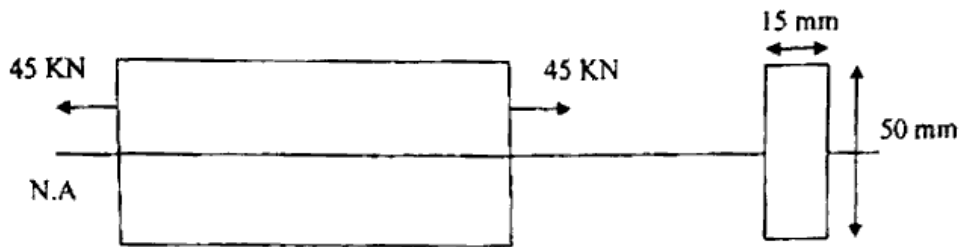
11. (a) A thin cylindrical shell of internal diameter d, thickness of the shell being t. Let the length of the shell be l. The shell is subjected to an internal pressure of intensity p. Calculate the expressions for circumferential (hoop) stress, hoop strain, longitudinal stress, longitudinal strain.

(b) A cylindrical air receiver for a compressor is 2 m in internal diameter and made of plates 12 mm thick. If hoop stress is not to exceed 90 Mpa and axial stress is not to exceed 60 Mpa, find safe pressure intensity. http://www.makaut.com   9+6=15

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