

B.Tech/ME/3rd Sem/MECH-2102/2015

2015

STRENGTH OF MATERIALS
(MECH 2102)

Time Alloted : 3 Hours

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : [10×1=10]
- i) Principal planes are the planes of
- (a) maximum and minimum shear stress
 - (b) zero shear stress
 - (c) The mean value of the normal stresses
 - (d) all of the above
- ii) For all common engineering materials, the value of Poisson's ratio is less than
- (a) 0.25
 - (b) 0.50
 - (c) -0.50
 - (d) 0.30

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- iii) The equivalent length of a column fixed at both ends is
- (a) 2L
 - (b) L
 - (c) 0.5L
 - (d) 0.7L
- iv) The relation between young's modulus (E), shear modulus (G) and poisson's ratio (μ) is given by
- (a) $E = 2G(1 - \mu)$
 - (b) $E = 2G(1 + \mu)$
 - (c) $E = 2G(1 - 3\mu)$
 - (d) $E = 2G(1 + 3\mu)$
- v) The bending moment diagram for a cantilever with point load, at the free end will be
- (a) A triangle with maximum height under free end
 - (b) A triangle with maximum height under fixed end
 - (c) A parabolic curve
 - (d) None of these
- vi) The dimension of young modulus of elasticity is given by
- (a) $M^1L^{-1}T^{-2}$
 - (b) $M^1L^{-1}T^{-1}$
 - (c) $M^1L^{-2}T^{-2}$
 - (d) $M^{-1}L^{-1}T^2$
- vii) When a shear force along a section is zero
- (a) BM is maximum or minimum
 - (b) BM is zero
 - (c) BM is infinity
 - (d) BM is practicable
- viii) A simply supported beam of span L is carrying a point load W at the mid-span. What is the deflection at the centre of the beam?
- (a) $\frac{WL^3}{48EI}$
 - (b) $\frac{WL^2}{48EI}$
 - (c) $\frac{5WL^3}{348EI}$
 - (d) $\frac{11WL^2}{120EI}$

- ix) Hoop stress for thin walled cylinder having diameter d , internal pressure p and thickness t is
- (a) $pd/2t$ (b) $pd/4t$
 (c) $2pd/t$ (d) pd/t
- x) If a closed coil helical spring of axial stiffness k is cut one fourth, the axial stiffness changes to
- (a) $k/4$ (b) k
 (c) $k/2$ (d) $4k$

GROUP - B

2. (a) Find the relation between young modulus (E), bulk modulus (K) and poisson's ratio (μ)
- (b) Fig.1 shows a horizontal rigid bar BDE supported by two vertical bars AB and CD. The bar AB of area 600 mm^2 is of aluminium while the bar CD of area 800 mm^2 is of steel. For a load of 40 kN applied at E find the vertical deflection of B, D and E. Take $E_a = 70 \text{ GPa}$ and $E_s = 200 \text{ GPa}$.

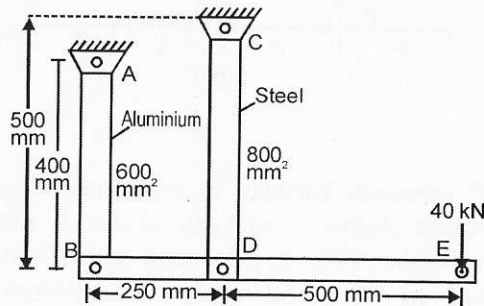


Fig.1

5+7 = 12

3. (a) Draw the stress-strain diagram for a ductile material and describe its all points.

- (b) Compute the maximum stress and total elongation in the stepped bar shown in Fig.2. Take $E = 200 \text{ GPa}$.

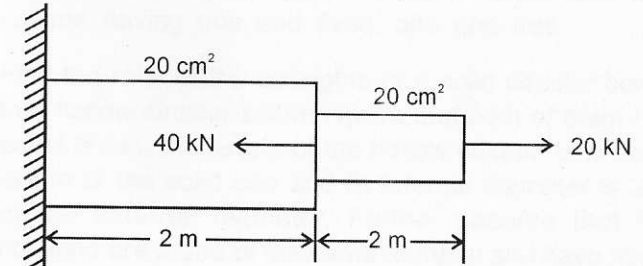


Fig.2

6+6 = 12

GROUP - C

4. (a) A cast iron pipe of 750 mm diameter is used to carry water under a head of 60 m . Determine the thickness of the pipe if the permissible stress is to be 20 MPa .
- (b) The state of stress at a point of a rectangular object is shown in Fig.3. Determine the principal stresses and maximum shear stress and its inclination.

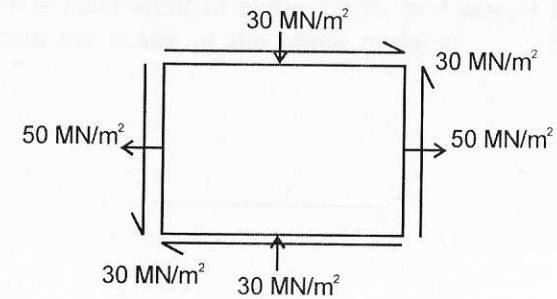


Fig.3

5+7 = 12

5. (a) A beam 3m long, simply supported at the ends, is carrying a point load W at the centre. If the slope at the end of the beam should not exceed 1° , find the deflection at the centre of the beam.
- (b) A simply supported beam of length l carrying a uniformly distributed load w per unit run over the whole length. Determine the slope at each end and the maximum deflection.

6+6 = 12

Group - D

6. (a) What do you mean by point of contra-flexure?
- (b) A 14 m long simply supported beam with an overhang at the right end is loaded as in Fig.4. It carries a load of 12 kN applied through a bracket and also a uniformly distributed load for 8 m of length from right end. Draw the shear force and bending moment diagrams.

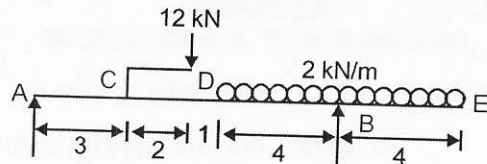


Fig.4

2+10 = 12

7. (a) A circular steel pipe of external diameter 60 mm and thickness 8 mm is used as a simply supported beam over an effective span of 2 m. Determine the maximum concentrated load that can be carried by it at mid span, if permissible stress in steel is 150 MPa.
- (b) Show that in a beam of rectangular section maximum

shear stress is $\frac{3}{2} \tau_{avg}$.

7+5 = 12

GROUP - E

8. (a) Find out the expression for Euler's critical load for a column having one end fixed, one end free.
- (b) Find the ratio of the strengths of a solid circular column to a hollow circular column given that both of them have equal areas, the length of the hollow column is twice the length of the solid one and its internal diameter is $\frac{2}{3}$ rd of the external diameter. Further assume that both columns are made of the same material and have hinged ends.
9. (a) A composite shaft is made from steel and a brass core. The external diameter of the steel shaft is 60 mm and the outside diameter of the brass core is 30 mm. The one end of the shaft is fixed and torque of 400 N-m is applied on the other end. Determine the maximum shear stress in the steel and in the brass core and the value of angle of twist at the end of shaft. Neglect the weight of the shaft and take G (steel) = 70 GPa and G (brass) = 40 GPa.
- (b) Prove that a hollow shaft can withstand higher torque than a solid shaft of same length and weight if the two shafts are made of the same material.

6+6 = 12

6+6 = 12