3E1631

B.Tech. (Sem.III) (Main/Back) Examination, Jan.-2016
Mechanical Engineering
3ME1 Mechanics of Solids-I

Time : 3 Hours

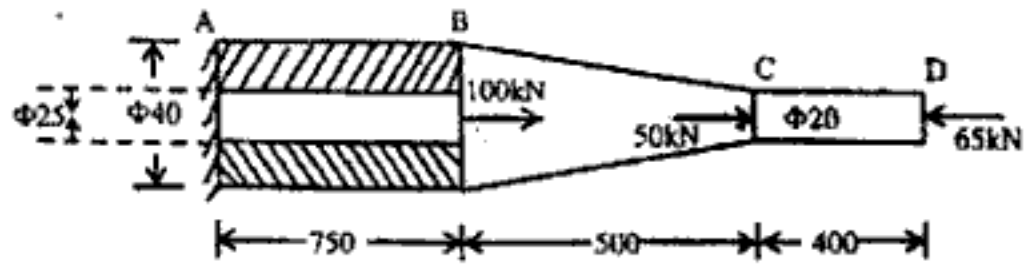
Total Marks : 80
Min. Passing Marks : 26

Instructions to Candidates :
Attempt any five questions selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

UNIT-I

1. (a) The width of a rectangular taper plate of length 'L' varies uniformly from 'a' at one end 'b' at other end. Find the extension of the plate when it carries an axial pull P and having uniform thickness t. Take modulus of elasticity as E. (8)

(b) Determine the net deformation in the diagram. Take E = 105Gpa. (8)



OR

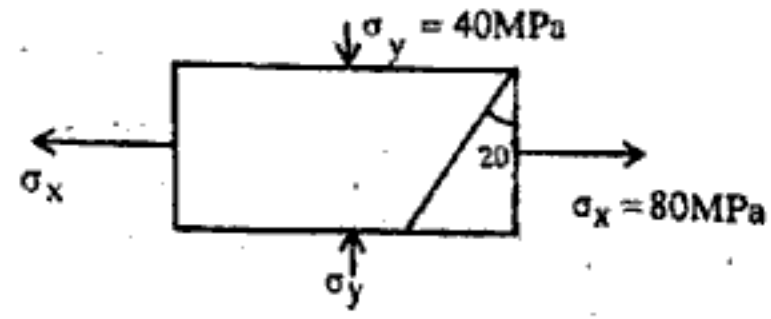
1. (a) A flat bar of aluminium alloy 24mm wide and 6mm thick is placed between two steel bars each 24mm wide and 9mm thick to form a composite bar 24mm × 24mm. The three bars are fastened together to their ends when the temperature is 10°C. Find the stresses in each of the material when the temperature of whole assembly is raised to 50°C. If at the new temperature, a compressive load of 20kN is applied to the assembly, what are the final stresses in steel & Al. (8)

$E_S = 2 \times 10^5 N/mm^2$
$E_A = 2/3 \times 10^5 N/mm^2$
$\alpha_S = 1.2 \times 10^{-5}/°C$
$\alpha_A = 2.3 \times 10^{-5}/°C$

(b) Derive the relationship between Modulus of Elasticity, Modulus of Rigidity and Poisson's Ratio of an elastic body. (8)

UNIT-II

2. (a) The principal stresses at a point across two perpendicular planes are 80Mpa(T) and 40MPa (comp.). Find the normal, tangential and resultant stresses on a plane inclined at 20° to the axis of major principal plane. (8)



(b) Explain and derive concept of Equivalent Bending and Equivalent Twisting Moment. (8)

OR

2. (a) In a material subjected to strain, the resultant stress across a plane is 60MPa tensile, inclined at 30° to its normal including clockwise shear on the plane. The normal stress across the plane at right angle to this one is $40N/mm^2$ tensile. Find the principal stresses and locate their plane. (8)

(b) Write short note on theories of failure. (8)

UNIT-III

3. (a) A simply supported beam of span L is carrying uniformly distributed load W over its entire span. Calculate S.F. and B.M. Also Draw S.F.D. and B.M.D. (6)

(b) Derive relation between load, shear force and bending moment at a section of Beam. (6)

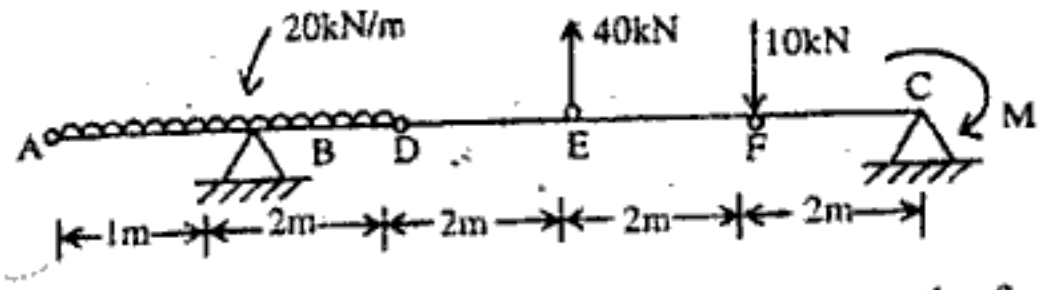
(c) Explain following:

(i) Hogging & Sagging Bending Moment

(ii) Contra-flexure point (4)

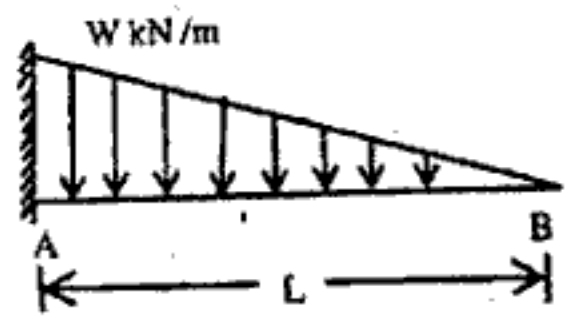
OR

3. (a) A Beam ABC is loaded and supported as shown below. Find the magnitude of the clockwise moment (M) to be applied at (C) so that reaction at (B) will be 30kN upward and then draw Shear Force and Bending Moment diagram for the beam.



(10)

(b) For a cantilever carying load whose intensity varies from zero at the free end to (W) per unit run at the fixed end. Find out bending moment and shear force value at ends. Also draw S.F. and B.M. diagram.



(6)

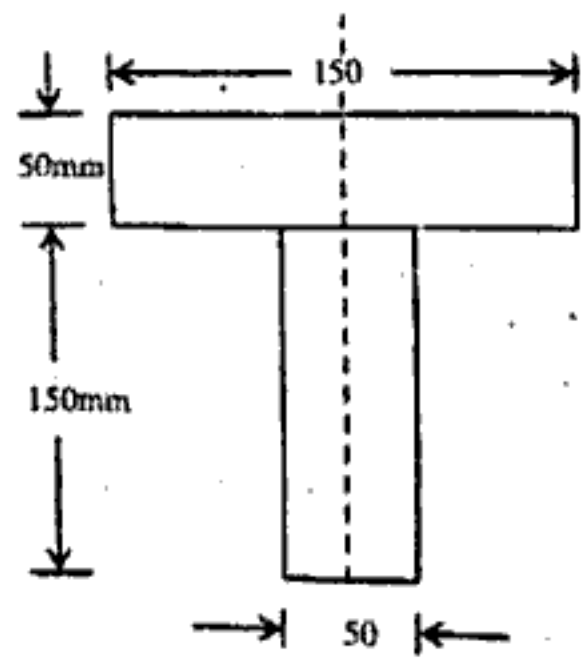
UNIT-IV

(a) Two 50 × 150 rectangular timber section are glued together to form a T-section as shown in figure. If bending moment of 4kN-m is applied to this about the horizontal axis.

(i) Find the stresses at the extreme fibers.

(ii) Calculate total compressive force developed by normal stress above neutral axis.

(iii) Find the total force due to tensile bending stress.



(b) What is hoop and longitudinal stress? Also derive formula for wall of cylinder.

OR

4. (a) Prove the relation $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$

M = Bending stress
Y = Distance from N.A.
E = Young's modulus
R = Radius of curvature
I = Moment of Inertia

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(b) Draw and explain the shear stress distribution over the rectangular cross section. (6)

(c) A thin cylindrical pressure vessel of 500 mm diameter is subjected to an internal pr. of 2 N/mm^2. If the thickness of vessel is 20 mm, find the hoop stress, longitudinal stress and maximum shear stress. (4)

UNIT - V

5. (a) A solid steel shaft is subjected to Torque of 45kN-m. If the angle of twist is 0.5° per meter length of shaft and shear stress should not exceed 90N/mm^2, find:
(i) Suitable diameter of shaft
(ii) Final maximum shear stress and angle of twist for diameter of shaft selected.
(iii) Maximum shear strain in shaft.
Take modules of rigidity = 80Gpa (8)

(b) A bar of length 4m is used as a simply supported beam, subjected to uniformly distributed load of 30kN/m over the whole span, deflects 15mm at centre. Determine crippling load when it is used as a coloum with following end condition :
(i) Both ends are pin jointed
(ii) One end fix and other end hinged
(iii) Both end fixed (8)

OR

(a) Explain following :
(i) Long and short column (2)
(ii) Crippling load (2)
(iii) Slenderness ratio (2)
(iv) Rankine formula (2)

(b) Find the Euler's crushing load for a Hollow Cylinder Cost Iron Column 120mm extreme diameter and 20mm thick, if it is 4.2m long and hinged at both end. E = 80kN/mm^2.
Compare this load with crushing load given by Rankine's forumla, using f = 550N/mm^2, and α = 1/1600 (Rankine const.) (8)

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