3E1411

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3E1411

B. Tech. (Sem. III) (Main & Back) Examination, January - 2013
Production & Industrial Engg.
3PI1 Mechanics of Solids (Common for ME/AE)

Time : **3** Hours] [Total Marks : **80**
[Min. Passing Marks : **24**

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.

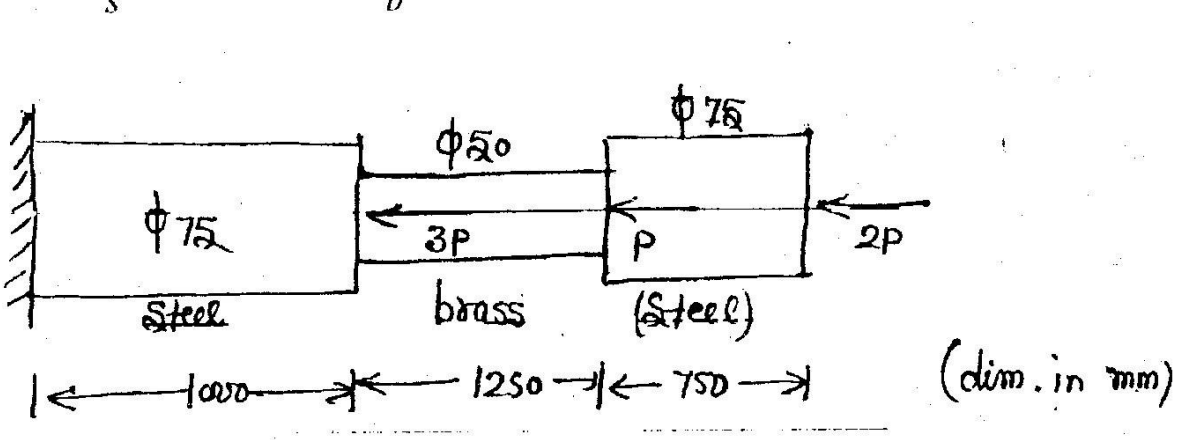
Use of following supporting material is permitted during examination.
(Mentioned in form No. 205)

1. Nil 2. NIL

UNIT - I

1 (a) What is generalized Hook's law. Derive the relation for volumetric strain in Tri-axial loading (3D state). 4

(b) A composite rod is loaded by various axial forces. Determine the largest value of P such that the stress in steel does not exceed 150MPa and in brass does not exceed 75MPa. Hence determine Elongation of the bar. Take $E_s = 200GPa,\ E_b = 75GPa$



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(c) Define following :

(i) Lateral strain and poission's ratio.

(ii) Thermal Stress and strain

(iii) Factor of safety. **4**

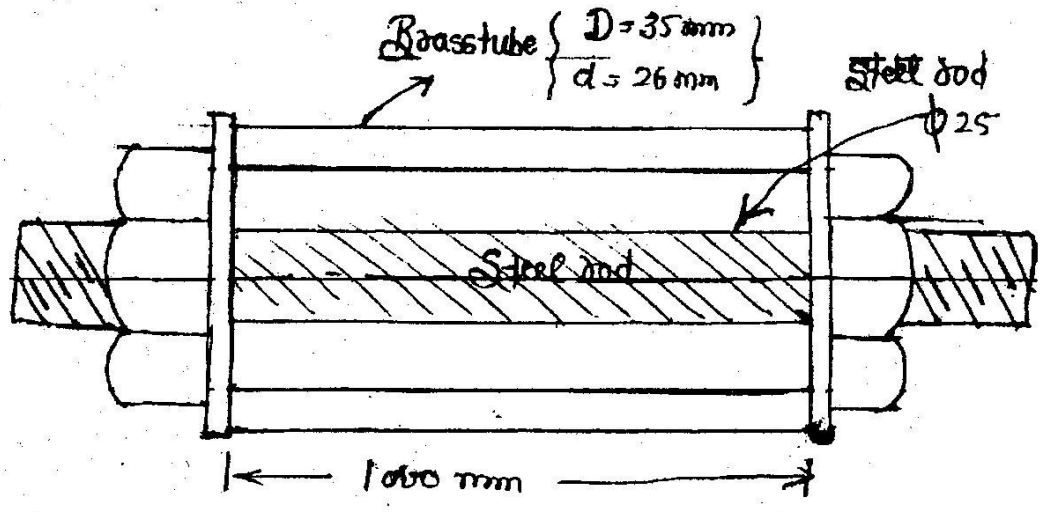
OR

2 (a) A solid steel rod having diameter 25mm is encased in a brass tube having its Internal diameter 26 mm and external diameter 35mm. The legnth of the assembly is 1000mm as shown. If steel rod is tensioned to carry a force. 25kN and is anchored at the end by tightening nut. Determine.

(i) Stresses in Steel rod and brass tube.

(ii) Change in stresses of entirely assembly subjected to tensile force of 15 kN.

(iii) Stress when it under goes decrease in temp. by 100°C.



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(b) A rectangular taper plane of length L. The width of plate varies uniformly from 'a' at one end and 'b' at other end. Find the extension of plate when it carries axial pull of P and having inform thickness t. The modulus of elasticity is E.

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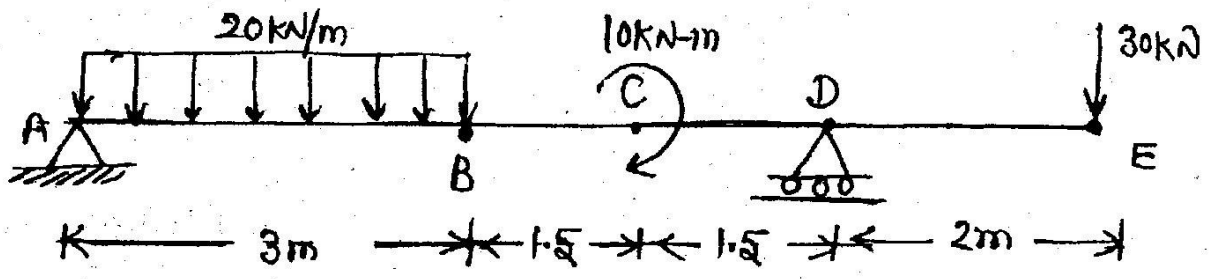
UNIT - II

3 (a) Draw S.F. and B.M. diagram for the beam and locate point of inflection.



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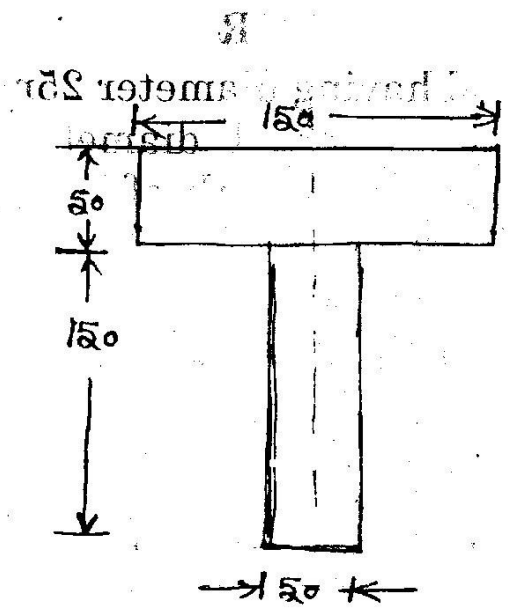
(b) Two 50mm × 150mm rectangular timber section are glued together to form a T-section as shown. If sagging bending moment of 4 KN is applied to this beam about the horizontal axis. Find.



(i) Find the stress at extreme fibre.

(ii) Calculate total compresive force developed

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

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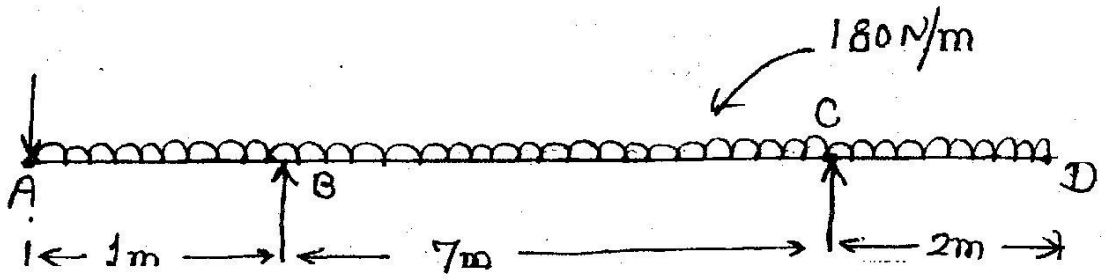
4 (a) Determine shear force and bending moment. Draw S.F.D., B.M.D. find point of contra flexure. If any



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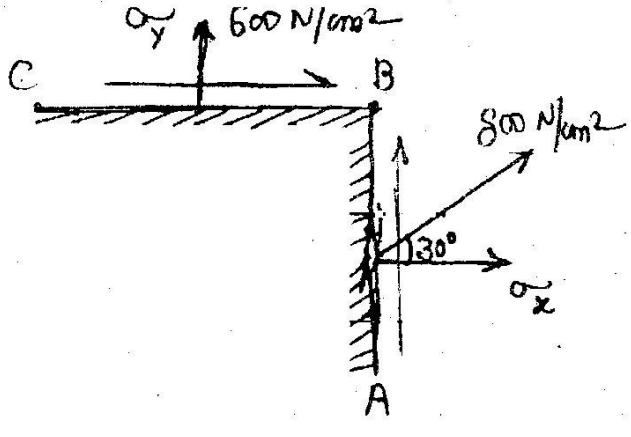
(b) When point load of 100kN applied at the centre of its span of beam is 5.5m. Size of the beam is 230mm × 460mm. Find the maximum shear stress and ratio of maximum and average shear stress. Plot stress distribution diagram.

6

UNIT-III

5 (a) The Intensity of a resultant stress, on a plane AB, given below at a point in material under stress is 800 N/cm^2 and it is Inclined at 30° to the normal to the plane. The normal component of stress on another plane BC. a rightangle to plane AB is 600 N/cm^2 Determine.



(i) Resultant stress on plane BC
(ii) Principal stress and their directions
(iii) Max shear stress and their planes.

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(b) Explain :

(i) Maximum shear stress theory
(ii) Maximum principal strain theory

4

(c) Derive relation for equivalent bending and Twisting for shaft Subjected to combined bending and twisting.

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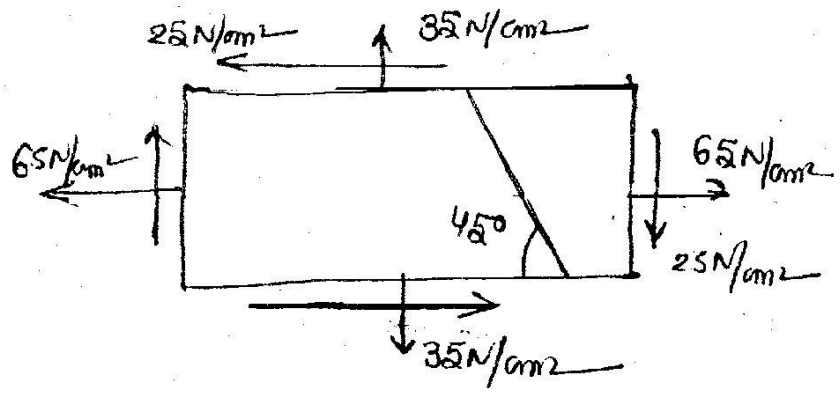
6 (a) A point in a strained material is subjected to stress. Using Mohr's circle methods. Draw and find normal, Tangential and resultant stress across oblique plane.



also find Principal stress and their direction.

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(b) A bolt is under an axial pull of 8kN together with a transverse shear force of 3kN. Calculate its diameter according to :

(i) Maximum principal stress theory

(ii) Maximum shear stress theory.

(iii) Strain energy theory

Elastic limit = 270 N/mm^2, $\mu = 0.3$, Factor of safety = 3

8

UNIT - IV

7 (a) What are the assumption made in theory of Torsion. Derive Torsion formula.

$$\frac{T}{J} = \frac{C\theta}{L} = \frac{\tau}{R}$$

8

(b) A hollow shaft of diameter ratio $\frac{3}{8}$ (Inter to outer) is to transmit 375kN power at 100rpm. The maximum Torque being 20% greater than the mean. The shear stress is not to exceed than the 60 N/mm^2 and twist in a length of 4m not to exceed 2^o. Calculate its external and internal diameter which would satisfy bothe the above condition.

Assume $G = 0.85 \times 10^5 N/mm^2$.

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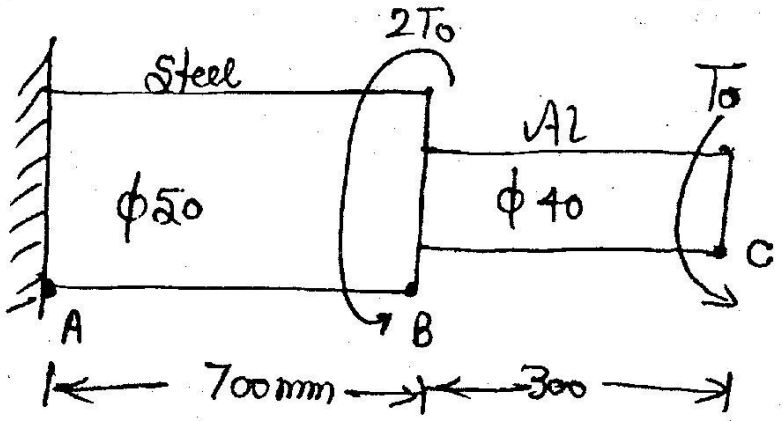
8 (a) A compound shaft consist of a steel segment and an aluminium segment and is acted upon by Two Torques as shown. Draw the Twisting moment diagram. Determine maximum permissible value of T_o subjected to following conditions.



(i) Max shear stress in steel = 85MPa

(ii) Max. shear stress in AL=50MPa

(iii) Angle of twist at free end > 5°.

$G_{steel} = 80GPa,\ G_{AL} = 28GPa$

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(b) A hollow cylindrical column is fixed at both ends. The length of column is 4m and carries axial load of 250kN. Design the column by Rankine's formula. Adopt a FOS of 5. The internal diameter is 0.8 times of external diameter. Take $F_c = 550\ N/mm^2$ and $\alpha = \frac{1}{1600}$ in Rankine formula.

5

(c) Explain :

(i) Critical stress

(ii) Limitations of Euler's formula

3

UNIT - V

9 (a) What is transverse deflection of beam. Derive differential equation for deflection.

$$EI\frac{d^2y}{dx^2} = M$$

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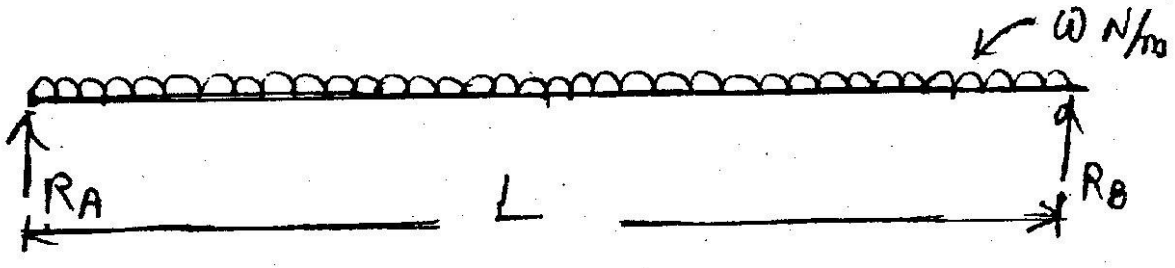
(b) A beam subjected to a uniformly destributed load w over its entire span. Determine maximum slope and deflection by Double Integration method.



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10 (a) Write short note on :

(i) Mohr's I and II Theorem for slope and deflection.

(ii) Castigliano's theorem. 8

(b) An unknown weight falls through 10mm on a collar rigidly attached to the lower vertical bar. 3m long and 600 mm^2 in section. If the maximum Instanteneaus extension is 2mm. What is the corresponding stress and the value of unknown weight ?

E=200GPa.

4

(c) Explain Maxwell Theoram of reciprocal displacement.

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