3E1631

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B. Tech. (Sem. III) (Main/Back) Examination, December - 2017
Aeronautical Engg.
3AN1 Mechanics of Solids (AE, ME, PI, AN)

Time : 3 Hours **Maximum 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 materials is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

UNIT - I

1 (a) Briefly explain :

(i) Poisson ratio

(ii) Lateral strain

(iii) Complementary shear stress

(iv) Thermal stress and strain

(v) Generalized Hook's law

(vi) Factor of safety. 8

(b) A composite rod as shown in figure is loaded by various axial forces, determine largest value of P such that the stress in steel does not exceed 150 MPa and that in brass does not exceed 75 MPa. Hence determine elongation of the bar. Take

$E_{steel} = 200\ GPa$ & $E_{brass} = 75\ GPa.$

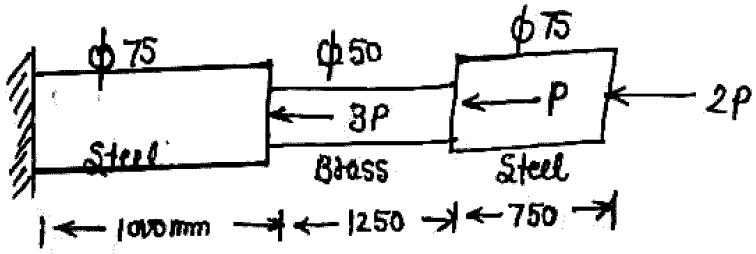

Fig. 1

8

OR

2 (a) A rectangular taper plate of length 'L'. The width of plate varies uniformly from 'a' at one end and 'b' at other end. Find extension of plate when it carries an axial pull P and having uniform thickness t.

8

(b) A steel tube of 45 mm in external diameter and 3 mm thickness encloses centrally a solid copper bar of 30 mm diameter. The bar and the tube are rigidly connected together at the ends at a temperature of 30°C. Find the stress in each metal when heated to 180°C. Also find increase in the length, if original length of assembly is 300 mm. Coefficient of expansion for steel and copper are 1.08×10^{-5} and 1.7×10^{-5} respectively per degree centigrade.

$E_{steel} = 2.1 \times 10^{-5}\ N/mm^2$, $E_{cu} = 1.1 \times 10^{-5}\ N/mm^2$ for copper.

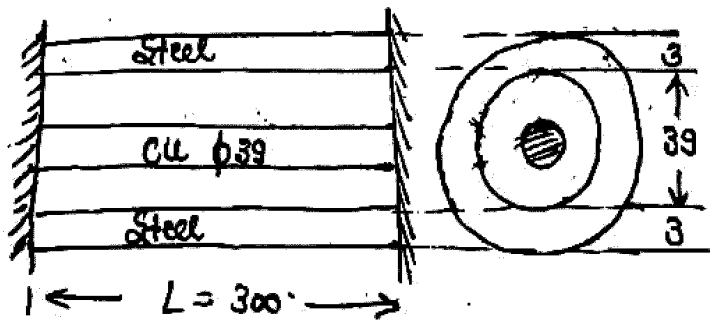

Fig. 2

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UNIT - II

3 (a) Define and explain theory of failure :

(i) Maximum principal stress theory

(ii) Maximum strain energy theory. 6

(b) A short metallic column of 500 mm^2 cross sectional area carries an axial compressive load of 100 kN for a plane inclined at 60° with the direction of load. Calculate :

(i) Normal stress

(ii) Tangential stress

(iii) Resultant stress

(iv) Maximum shear stress

(v) Obliquity of resultant stress. 6

(c) Derive equation for equivalent Twisting and bending moment. 4

OR

4 (a) Find by Mohr's circle method Normal; and shear stress on section AB. Also find Max. shear stress.

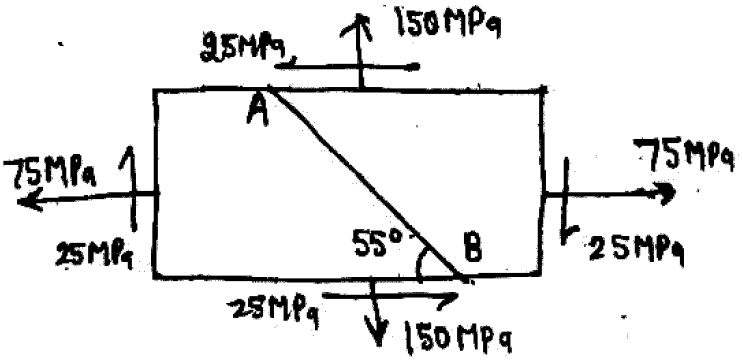

Fig. 3 8

(b)

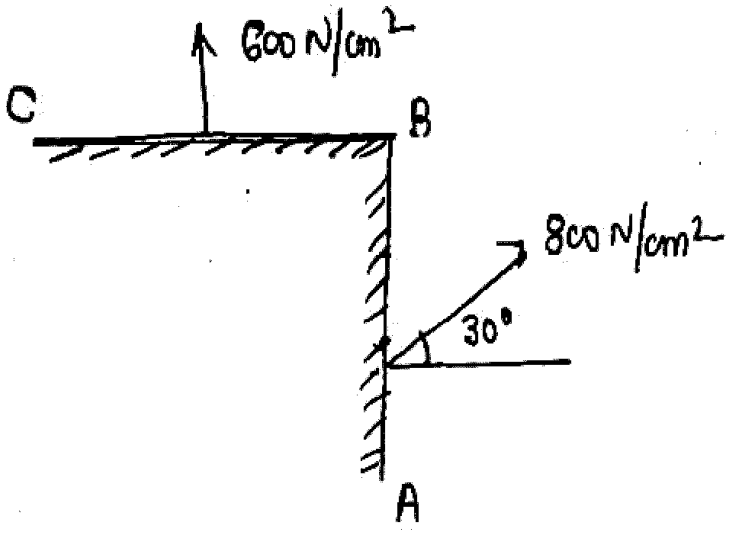

Fig. 4

Determine following :

(i) Resultant stress on plane BC

(ii) Principal stresses and their directions

(iii) Max. shear stresses and their planes. **8**

UNIT - III

5 (a) Derive relation between load shear force and bending moment. **6**

(b) Draw S.F. and B.M. diagram and find point of contraflexure if any.

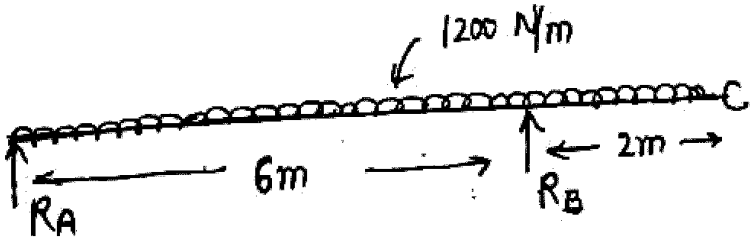

Fig. 5 **10**

OR

6 (a) Explain different types of beams, load and supports. 8

(b) Draw S.F. and B.M. diagram of simply supported beam of span 2.5 m subjected to U.D.L. and clockwise couple.

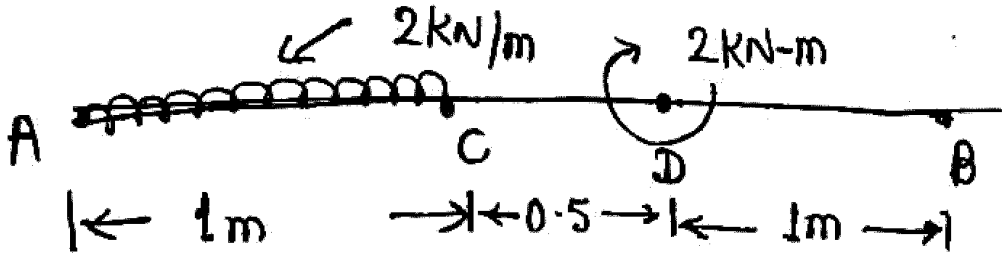

Fig. 6

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UNIT - IV

7 (a) What is pure bending ? What are the assumptions in theory of bending ? 4

(b) A rectangular beam 60 mm wide and 150 mm deep is simply supported over a span of 4 m. If the beam is subjected to U.D.L. of 4.5 kN/m. Find maximum bending stress in the beam. 4

(c) Derive flexure formula for beam.

$$\frac{M}{I} = \frac{a}{y} = \frac{E}{R}$$

8

OR

8 (a) Show for Triangular section the distribution of shearing stress. 6

(b) Two 150 × 150 mm rectangular timber section glued together to form a T-section as shown in figure. If bending moment 4 kN-m applied on beam about horizontal axis then find :

(i) Stress at extreme fibres

(ii) Calculate total compressive force

(iii) Total force due to tensile bending stress.

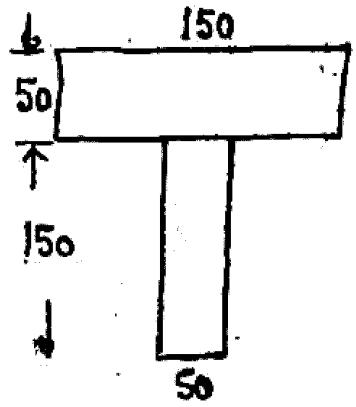

Fig. 7

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UNIT - V

9 (a) Derive the torsion equation and state the assumptions made. 8

(b) A hollow shaft of diameter ratio 3/8 (inner to outer) is to transmit 375 kW at 100 rpm. The max. torque 20% more than mean torque. Shear stress not to exceed 60 N/mm^2 and twist in the 4 m length is not to exceed 2°. Calculate inside and outside diameter which satisfy both the conditions

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

8

OR

10 (a) Explain Euler's theory and assumptions made in theory. Also brief the limitation of Euler's formula. 4

(b) Determine crippling load for a T-section of dimensions 12 cm × 12 cm × 2 cm and of length 6 m when it is used as column with one of its end fixed and other hinged $E = 2 \times 10^5 \ N/mm^2$. 6

(c) Find Euler's crushing load for a hollow cylindrical cast from column 120 mm extreme diameter and 20 mm thick. If it is 4.2 m long and hinged at both ends. Take $E = 80 \ kN/mm^2$. Compare this load with crushing load given by Rankine formula using constant $f = 550 \ N/mm^2$ and $\dot{a} = 1/1600$. 6