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B. E. (Fourth Semester) Examination, ~~2020~~ APR-MAY 2022

(New Scheme)

(Mech. Branch)

MECHANICS of SOLIDS - II

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

***Note** : Part (a) of each question is compulsory. Attempt any **two** part from (b), (c) and (d). Assume suitable data if missing.*

Unit - I

1. (a) Define : 2

(i) Strain energy.

(ii) Impact loading

(b) A bar of length 'L' and cross-sectional area 'A' hangs vertically from the ceiling and has a collar firmly attached at its lower end. Show that the maximum instantaneous strees induced in the bar when a weight 'W' falls freely on the collar through a height 'h' is given by :

$$\sigma_{max} = \frac{W}{A}\left[1+\sqrt{1+\frac{2AEh}{WL}}\right] \qquad 7$$

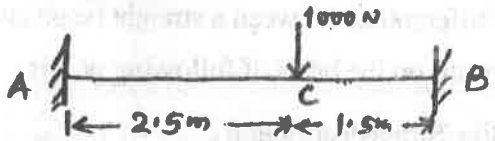
(c) Using castigliano's theorem, obtain the deflection at the centre of a beam carrying a UDL of 20 kN/m over the whole span. The beam is simply supported over a span of 3 m. Take $EI = 2{\cdot}5\ \text{MN}-\text{m}^2$. 7

(d) A bar 100 cm in length is subjected to an axial pull such that the maximum stress is equal to 150 MPa. The area of cross-section of the bar is 2 cm^2 over a length of 95 cm and for the middle 5 cm length, it is 1 cm^2. If $E = 200\,\text{GPa}$, calculate the strain energy stored in the bar. 7

Unit - II

2. (a) What is the effect of sinking of one support with respect to the other on the fixing moments and support reactions of a fixed beam? 2

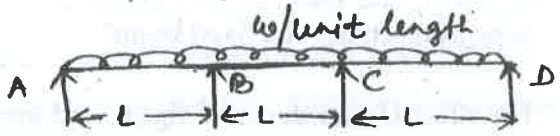
(b) For a fixed beam shown in fig.-1, find the slope and deflection under the load. Assume EI to be constant. 7



(c) A fixed beam of 5 m span carries a point load of 150 kN at 3m from the left end. If the right and sinks by 1.5 mm, find the fixing moments end reactions at the supports. Take $E = 2\times18\ \text{kN/m}^2$ and $I = 10000\ \text{cm}^4$. 7

(d) A continuous beam ABCD having three equal spans of length 'L' each is shown in fig.-2. It carries a uniformly distributed load 'w' per unit length over its entire length. It is freely supported on all

supports, which are at the same level. Draw the B.M. and S.F. diagrams for the beam. 7



Unit - III

3. (a) Differentiate between a straight beam and curved beam on the basis of following points :

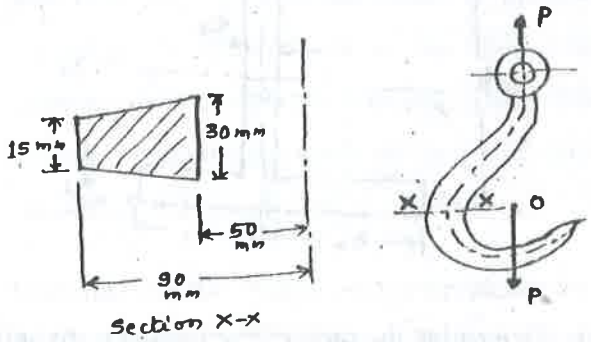
(i) Stress distribution

(ii) Position of neutral axis 2

(b) A curved bar of rectangular section, initially unstressed, is subjected to bending moment of 1500 N-m which tends to straighten the bar. The cross-section is 4 cm wide by 5 cm deep in the plane of bending, and the mean radius of curvature is 10 cm. Find the position of the neutral axis and magnitudes of the greatest bending stress. 7

(c) A crane hook has a trapezoidal cross-section as shown in fig.-3. Determine the maximum load to

be carried by the hook if the working stress is 150 MN/m^2. 7



(d) A ring made of 2.5 cm diameter steel bar carries a pull of 10 kN. Calculate the maximum tensile and compressive stresses in the material of the ring. The mean radius of the ring is 15 cm. 7

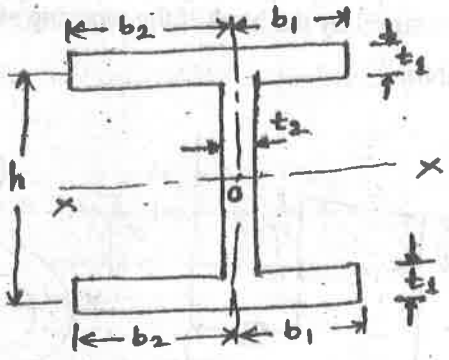
Unit - IV

4. (a) Define the following : 2

(i) Unsymmetrical bending

(ii) Shear centre

(b) Locate the shear centre of an unequal I-section shown in fig.-4. The section is symmetrical about X-X axis. 7



(c) Determine the ratio of the buckling strengths of two columns of circular section one hollow and other solid when both are made of the same material, have the same length, cross-sectional area and end-conditions. The internal diameter of the hollow column is half of its external diameter. 7

(d) Derive the Rankine's formula for buckling load of columns. Explain how the Rankine's formula is applicable to all columns whether they are short or long for determining the crippling load. 7

Unit - V

5. (a) What is compound cylinder? Explain the purpose of employing compound cylinders. 2

(b) A cylindrical shell is 3 m long, 0.75 m in diameter and 12.5 mm thick at atmospheric pressure. Calculate the dimensions of the shell when subjected to an internal pressure of 1.5 MPa. What is then the maximum shear stress in the shell? Assume $E = 210$ GPa and $\mu = 0{\cdot}25$. 7

(c) Calculate the thickness of metal necessary for a thick cylindrical shell of internal diameter 160 mm to with stand an internal pressure of 25 MN/m^2, if maximum permissible tensile stress is 125 MN/m^2. 7

(d) A compound cylinder is to be made by shrinking on outer tube of 200 mm external diameter on to an inner tube of 100 mm internal diameter. If the greatest circumferential stress in the inner tube is to be $\frac{2}{3}$ rd of the greatest circumferential stress in the outer tube, determine the common diameter. 7