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B. E. (Fourth Semester) Examination, April-May 2021

(Old Scheme)

(Mech. Engg. 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*** *parts from (b), (c) and (d) in question 1, 2, 3 and 4. Solve any* ***one*** *part from question 5.*

Unit-I

1. (a) Define strain energy. 2

(b) State and prove Castigliano's theorem. 7

(c) A trolly of weight 100 kN is descending slope with a uniform velocity of 2 m/s at the end of a steel cable which is wound round a drum. When the length of the cable laid out is 600 m, emergency brakes are suddenly applied and the wagon is brought to a halt. If the cross-sectional area of the cable is 6 square cm and $E = 200$ GPa, find the stress developed in the cable. What would be the stress if the length of the cable laid out is 240 m? 7

(d) A beam 4 m length is simply supported of the ends and carries a uniformly distributed load of 5 kN/m length. Determine the strain energy stored in the beam. $E = 200$ GPa and $I = 1200$ cm^4. 7

Unit-II

2. (a) Define linked and continous beam. 2

(b) A fixed beam of 6 m span carries a uniformally distri-buted load of 2 kN/m run. If $E = 2 \times 10^8$ kN/m^2 and $I = 0{\cdot}48 \times 10^{-4}$ m^4,

Find :

(i) Bending moment at the centre

(ii) Maximum deflection 7

(c) A linked beam of 6 m spam carries point loads of 1000 kN and 75 kN as shown in fig (1). Find the followings :

(i) Fixing moments at the ends

(ii) Reaction at the supports

Draw the bending moment and shear force diagram also. 7

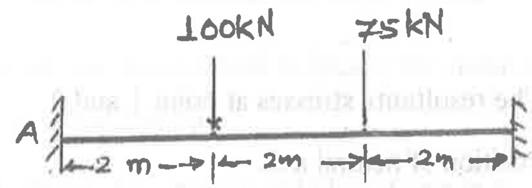


Fig. (1)

(d) A continuous beam *ABCD* of unifarm cross section is loaded as shown in fig. (2). 7

Find :

(i) Bending moments at the supports *B* and *C*

(ii) Reaction at the supports

Draw bending moment and shear force diagram also.

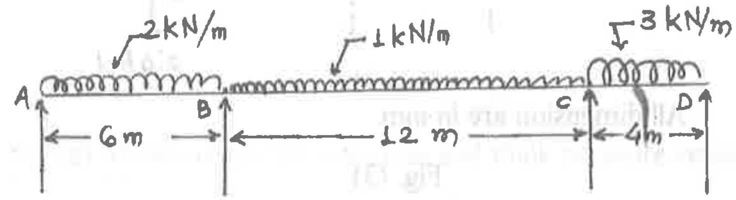


Fig. (2)

Unit-III

3. (a) List the assumptions made in Winkler-Bech theory. 2

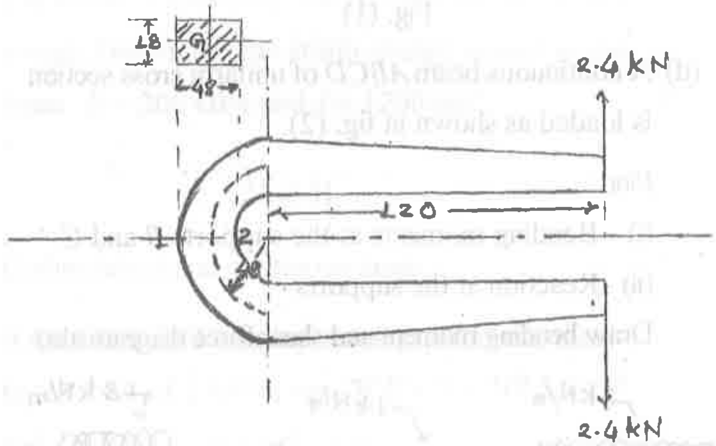
(b) Prove the Winkler-Bech theory as application to bars of large initial curvature. 7

(c) Figure (3) shows a frame subjected to a load of 2·4 kN. 7

Find :

(i) The resultants stresses at point 1 and 2

(ii) Position of neutral axis



All dimension are in mm.

Fig. (3)

(d) A zing 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 large column and short column. 2

(b) Derive the equation to locate the shear centre for unequal I-section. 7

(c) Derive the equation of Euler's formula for a column fixed at one end and hinged at other. 7

(d) Calculate the safe compressive load on a hollow cast iron column (one end rigidly fixed and other hinged) of 150 mm external diameter, 100 mm internal diameter and 10 m length. Use Euler's formula with a factor of safety of 5 and $E = 95$ GN/m^2. 7

Unit-V

5. (a) Differentiate between thin and thick pressure vessel. 2

(b) A cylindrical shell 3 m long which is closed at the ends has an internal diameter of 1 m and a wall thickness of 15 mm. Calculate the circumferential and longitudinal stresses included and also change in the dimensions of the shell if it is subjected to an internal pressure of 1·5 MN/m^2. 14

Or

A thick walled closed end cylinder is made of an Al-alloy $\left(E = 72\text{ GPa}, \frac{1}{M} = 0\cdot 33\right)$, has inside diameter of 200 mm and outside diameter of 800 mm. The cylinder is subjected to internal fluid pressure of 150 MPa. Determine the principal stresses and maximum shear stress at a point on the inside surface of the cylinder. Also determine the increase in inside diameter due to fluid pressure. 14