Ref. No.: Ex/Arch/CE/T/123/2023

Bachelor of Architecture, First Year Second Semester Examination, 2023

STRUCTURAL MECHANICS – II

Full Marks – 100 **Time: 3 Hrs.**

- **Question-1 is compulsory.**
  Answer any FIVE from the rest (Q2 – Q9).

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1. Answer all questions - **(10 x 2 = 20)**

(A) Define Stress and Strain.

(B) Define the Modulus of Elasticity of a material?

(C) Define Hook's Law.

(D) State the assumptions of Hook's Law.

(E) Draw the typical Stress-Strain Curve for material Steel, marking the Elastic, Elasto-Plastic, Plastic zones, and Yield Point.

(F) Explain the terms Homogeneous material and Isotropic material.

(G) What is Poisson's Ratio? What are the typical values for Steel and Concrete?

(H) What is a determinate structure?

(I) Define the Section Modulus of a cross-section.

(J) What are the general locations on a cross-section where we get the maximum bending stress and maximum shear stress?

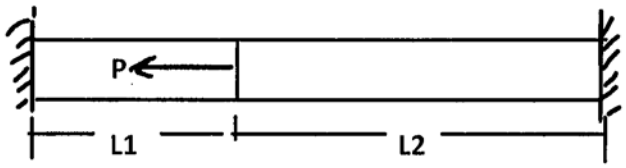
2. (A) Derive the relationship: $\Delta = (P.L) / (A.E)$, where the notations have their usual meaning. **(6)**

(B) A hollow right circular cylinder, made of Cast Iron, has an outside diameter of 120 mm. and an inside diameter of 60 mm. The length of the cylinder is 800 mm. An axial compressive force of 90 kN. is applied to the cylinder. Determine the total shortening of the cylinder. Also, determine the Normal stress under this load. Take the Modulus of Elasticity 100 GPa and neglect any possibility of lateral buckling of the cylinder. **(10)**

3. Determine the total increase of the length of a bar of length L and constant cross-section A, hanging vertically and subject to its self-weight and an axial tensile load P. The Elastic Modulus of the material of the bar is E and the Unit Weight is γ. **(16)**

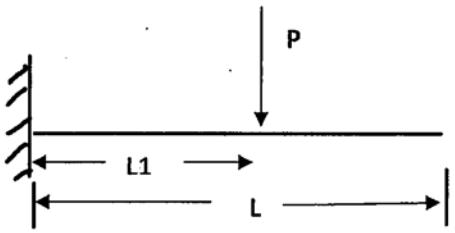
4. Consider a Steel Tube surrounding a solid Aluminium cylinder, the assembly is compressed between two infinitely rigid cover plates by a centrally applied load compressive load P. The Aluminium cylinder is 100 mm in diameter and the outside diameter of the Steel Tube is 150 mm. If, P = 500 kN, find the maximum stress in Steel and Aluminium. For Steel E = 200 GN/m^2 and for Aluminium E = 25 GN/m^2. **(16)**

5. The bar as shown in the figure below is of constant cross-section A and is held rigidly between the walls. A concentric axial load P is applied to the bar at a distance L_1 from the left end. Determine the reactions of the walls (at the left end and the right end) upon the bar. **(16)**

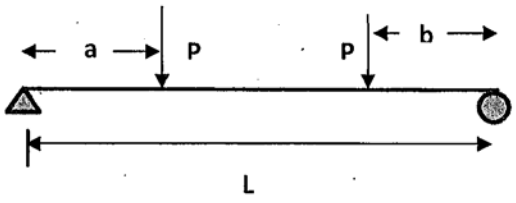


6. Draw the nature of the Bending Moment and the Shear Force diagrams for the following cases with values at the salient points – **(5 + 5 + 6 = 16)**

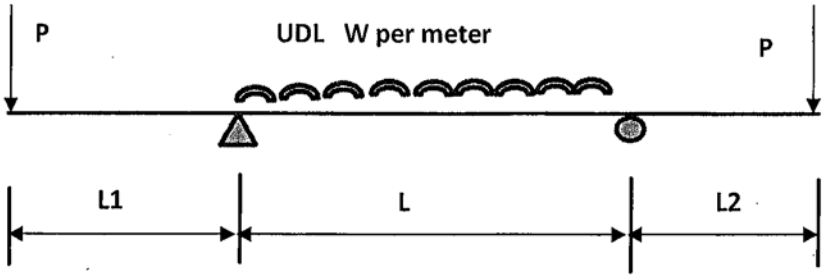
(A)



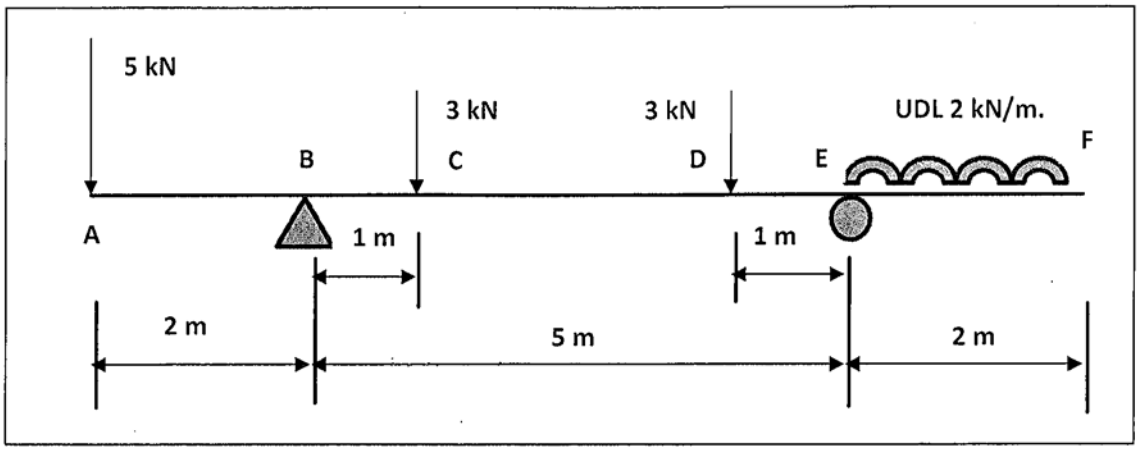
(B)



(C)



7. For the given beam and the loading as drawn in the picture below, find the values of Bending Moment and Shear Force at the locations A, B, C, D, E, and F on the beam. **(16)**



8. A Cantilever Beam of length 4 meters is subjected to a vertically downward point load of 10kN at the free end.
The cross-section of the beam is an I-Section with the following details –
Total Depth = 600 mm
Width of Top and Bottom Flanges = 300 mm
The thickness of the Top and Bottom Flanges = 20 mm
Thickness of Web = 10 mm
Determine the maximum Bending Stress in the beam and its location. **(16)**

9. A simply supported beam of a span of 5 meters is subjected to a UDL of 6 kN per meter over the entire span of the beam.
The cross-section of the beam is a Rectangular Hollow Section of 200 mm width and 300 mm depth (external dimensions) having a uniform thickness of 10 mm.
Determine the maximum Bending Stress, and maximum Shear Stress in the beam, and their corresponding locations. **(16)**