


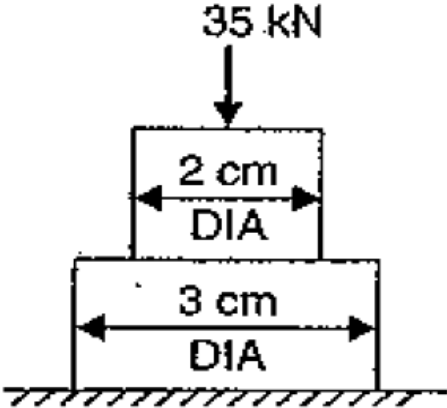
Name:	
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**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**  
**End Semester Examination, May 2023**

<b>Course: Strength of materials</b> <b>Program: B.Tech Mechanical and ADE</b> <b>Course Code: MECH 2012</b>	<b>Semester: IV</b> <b>Time: 03 hrs.</b> <b>Max. Marks: 100</b>
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**Instructions: Attempt all the questions. Assume suitable data if missing.**

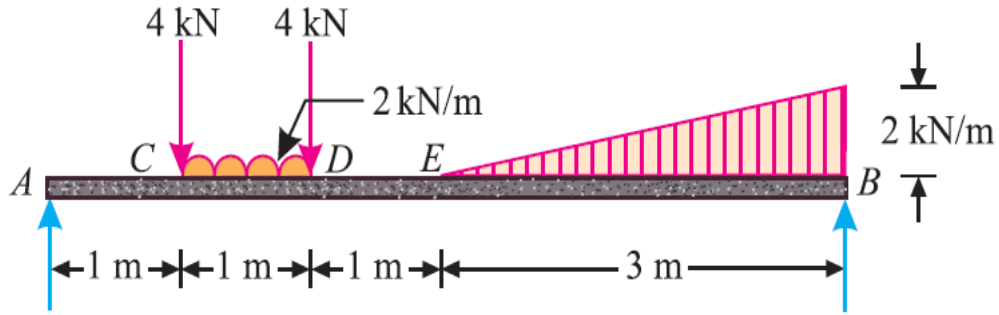
**SECTION A**  
**(5Qx4M=20Marks)**

Q No	Statement	Marks	CO
Q 1	A stepped bar as shown in figure is subjected to an axially applied load of 35 kN. Find the ratio of maximum and minimum stresses produced. <div style="text-align: center; margin: 10px 0;">  </div>	4	CO1
Q 2	Derive an expression of elongation in a conical rod hung upside down due to self-weight. Take the usual notations.	4	CO1
Q 3	Enlist the assumption made in deducing the equation for shear stress produced in a circular shaft subjected to torsion.	4	CO1
Q 4	Differentiate thin cylinder with thick cylinder on the basis of dimensional attributes and stresses developed.	4	CO1
Q 5	Discuss the analysis of shaft in series and parallel, subjected to pure torsional moments.	4	CO2

**SECTION B**  
**(4Qx10M= 40 Marks)**

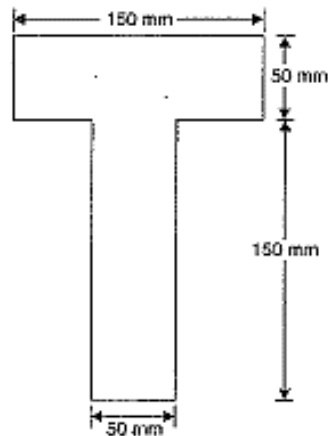
Q 6	A member ABCD is subjected to point loads $P_1$ , $P_2$ , $P_3$ and $P_4$ as shown in figure. Calculate the force necessary $P_2$ for equilibrium of the member, assuming $P_1 = 45$	10	CO2
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	<p>kN, <math>P_3 = 450</math> kN and <math>P_4 = 130</math> kN. Determine the total elongation of the member, assuming the modulus of elasticity to be <math>2.1 \times 10^5</math> N/mm<sup>2</sup>.</p> <p>The diagram shows a composite bar with three segments: AB, BC, and CD. Segment AB has a length of 120 cm and a cross-sectional area of 625 mm<sup>2</sup>. Segment BC has a length of 60 cm and a cross-sectional area of 2500 mm<sup>2</sup>. Segment CD has a length of 90 cm and a cross-sectional area of 1250 mm<sup>2</sup>. Forces <math>P_1</math>, <math>P_2</math>, <math>P_3</math>, and <math>P_4</math> are applied at the ends of the segments.</p>		
Q 7	<p>Derive an expression for longitudinal and circumferential stresses developed in a thin cylinder of thickness <math>t</math> and internal diameter <math>d</math>, which is subjected to an internal pressure <math>P</math>.</p>	10	CO2
Q 8	<p>The shear force acting on a beam of rectangular cross-section at a point is <math>F</math>. Show that the maximum shear stress developed is 1.5 times the average shear stress.</p>	10	CO3
Q 9	<p>Compare the torsional strength of a circular solid shaft with hollow shaft whose internal diameter is <math>2/3</math> of the outside diameter of same weight, same material, same length and same angle of twist.</p> <p style="text-align: center;">OR</p> <p>Two shafts of the same material and same lengths are subjected to the same torque. If the first shaft is of a solid circular section with 50 mm diameter and the second shaft is of hollow circular section, whose internal diameter is <math>3/4</math> of the outside diameter and the maximum shear stress developed in each shaft is the same, compare the weights of the shafts.</p>	10	CO3
<p><b>SECTION-C</b> (2Qx20M=40 Marks)</p>			
Q 10	<p>Draw the shear force and bending moment diagram for the beam loaded as shown in figure.</p>	20	CO3



Q 11

A beam is of T-section as shown in figure. The beam is simply supported over a span of 4 m and carries a uniformly distributed load of 2 kN/m run over the entire span. Determine the maximum tensile and maximum compressive stress.



OR

A beam of length 20 m is simply supported at the ends and carries two point loads 4 kN and 10 kN at a distance of 8 m and 12 m from left respectively. Calculate;

- Deflection under each load and
- Maximum deflection.

20

CO4