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**PRESIDENCY UNIVERSITY
BENGALURU**

SET B

**SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2024**

Semester : Semester III - 2022
Course Code : CIV2007
Course Name : Strength of Materials
Program : B.Tech.

Date : 04-JAN-2024
Time : 9:30AM - 12:30 PM
Max Marks : 100
Weightage : 50%

Instructions:

- (i) Read all questions carefully and answer accordingly.
 - (ii) Question paper consists of 3 parts.
 - (iii) Scientific and non-programmable calculator are permitted.
 - (iv) Do not write any information on the question paper other than Roll Number.
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PART A

ANSWER ALL THE QUESTIONS

4 X 5M = 20M

1. Write the assumptions made in Euler's theory
(CO4) [Knowledge]
2. Define Torsional Strength and Torsional Rigidity. Also, write the complete Torsional equation
(CO3) [Knowledge]
3. Define the following material constants: 1) Modulus of Elasticity 2) Modulus of Rigidity 3) Bulk Modulus. Also, write the equations relating these constants
(CO1) [Knowledge]
4. Determine the Torque (T) developed in a solid circular shaft if it has to transmit a power of 120kW rotating while at a speed of 200rpm. The shaft has a diameter of 300mm. Also, determine the polar moment of Inertia (J) of the shaft.
(CO3) [Knowledge]

PART B

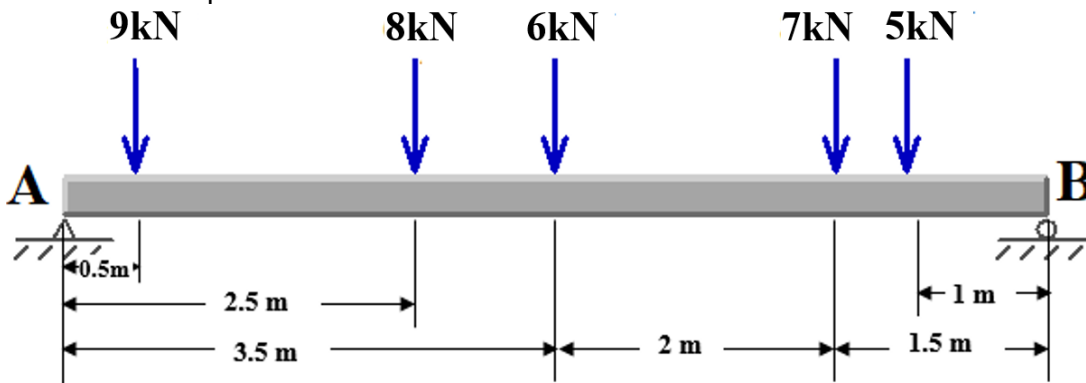
ANSWER ALL THE QUESTIONS

5 X 10M = 50M

5. A shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another. Shafts have many uses in transportation, aerospace, automotive and industrial manufacturing industries. The torsional moment or torque applied to the shaft as a result of its rotation induces shear stress in the shaft. For good design of a shaft, the shear stresses induced are kept within the elastic limit. If you are asked to design a solid circular shaft made up of mild steel to transmit a power of 80kW at 120 rpm, what will be the diameter you would propose for the shaft if the shear stress for steel is not to exceed 75MPa and the torque transmitted by each revolution is expected to exceed the mean by 30%. Take Modulus of Rigidity, $G = \text{N/mm}^2$

(CO3) [Comprehension]

6. Sketch the Shear force and Bending moment Diagram for the simply supported beam shown in Figure. Also locate the point of contraflexure

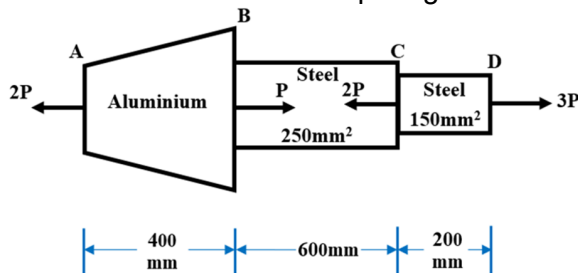


(CO2) [Comprehension]

7. Orientation of columns in any buildings is decided by architectural considerations (appearance) or structural considerations (efficient load transfer). From architectural considerations, the projection of columns outside the wall in a room should be avoided as they not only give bad appearance but also obstruct the use of floor space. With the above constraints, a rectangular column of 3.5m length and 230x450mm c/s is adopted for a commercial building. What would be the value of moment of inertia to be adopted for this column while determining the Euler's crippling load? Based on Euler's crippling theory, estimate the safe load that the column can carry if both of its ends are hinged and Factor of Safety (FoS) = 2. Take $E = \text{N/mm}^2$

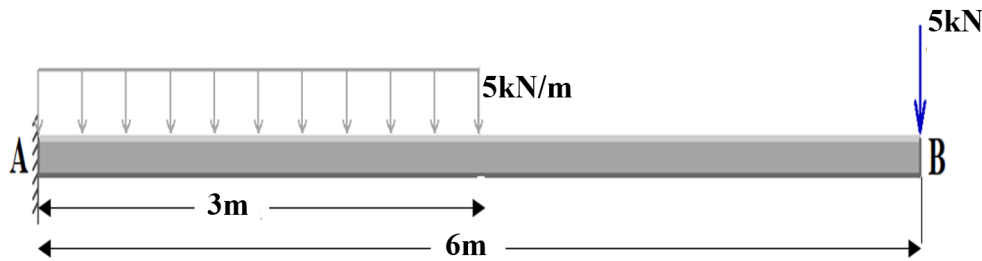
(CO4) [Comprehension]

8. A round bar with stepped portion made up of different materials is subjected to the forces as shown in Fig. Determine the magnitude of force P such that net deformation in the bar does not exceed 2mm. Modulus of Elasticity E for steel is 200 GPa and that for aluminium is 70 GPa. Big end diameter and small end diameter of the tapering bar are 50 mm and 25mm respectively.



(CO1) [Comprehension]

9. For the cantilever beam shown in Figure, Draw the SFD and BMD.



(CO2) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS

2 X 15M = 30M

10. A solid circular shaft is to be designed to transmit a power of 300 kW at 150 rpm speed. The allowable shear stress is not to exceed 50MPa. If the solid shaft is to be replaced by a hollow one made up of the same material, what will be the external and internal diameters of the hollow shaft that is required to be provided. The ratio of internal to external diameter may be adopted as 0.6. Compare the area of solid and hollow shaft obtained and comment on which one is more efficient in terms of the utilization of material. Take $G = 0.8 \times 10^5 \text{ N/mm}^2$
- (CO3) [Application]
11. A hollow circular column with both ends fixed has a length of 3m and its inner to outer diameter ratio = 0.7. The column carries a load of 200kN. Determine the diameters of the column. Take allowable stress as 300MPa, Rankine's constant $\alpha = 1/6000$ and FOS = 2. Also, compute the Slenderness ratio.
- (CO4) [Application]