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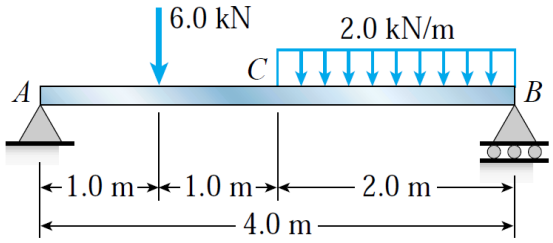
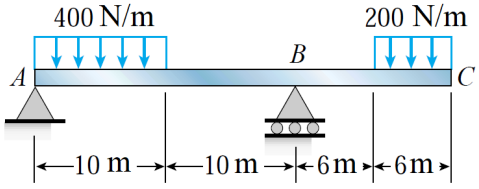
SLOT: C2+TC2

SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST – II
FALL SEMESTER 2023-2024

Programme Name & Branch : **B.Tech. (Mechanical/Automotive)**
Course Code : **BMEE202L**
Course Name : **Mechanics of Solids**
Faculty Name(s) : **DEVENDIRAN S, ASHIRBAD SWAIN, SENTHILNATHAN N, AKASH MOHANTY, MANIKANDAN M**
Class Number(s) : **VL2023240101698/ 1701/ 1702/ 1696/ 1699**
Exam Duration : **90 minutes** **Maximum Marks: 50**

General instruction(s): Answer all the questions. Assume the missing data (if any). Answer to-the-point and tabulate your final results.

Q. No	Question	Marks	CO	BL
1.	Determine the shear force V and bending moment M at the midpoint C of the simple beam AB shown in figure 1.  Fig. No. 1	10	2	5
2.	Determine the shear force V and bending moment M at a cross section located 16 m from the left-hand end A of the beam with an overhang shown in figure 2.  Fig. No. 2	10	2	5
3.	A vertical post 2.5-meters high must support a lateral load P = 12 kN at its upper end (figure 3). Two plans are proposed a solid wood post and a hollow aluminum tube. (a) What is the minimum required diameter d_1 of the wood post if the allowable bending stress in the wood is 15 MPa? (b) What is the minimum required outer diameter d_2 of the aluminum tube if its wall thickness is to be one-eighth of the outer diameter and the allowable bending stress in the aluminum is 50 MPa?	10	3	5

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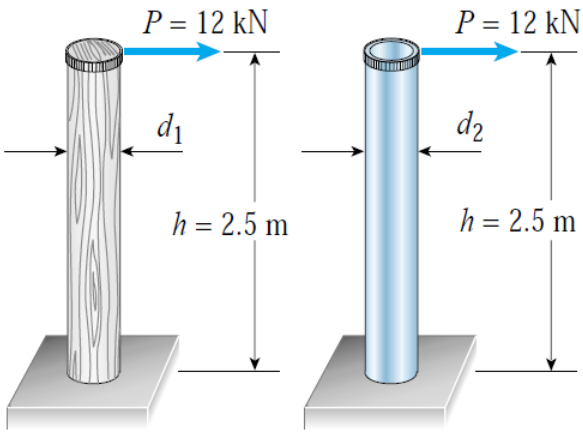
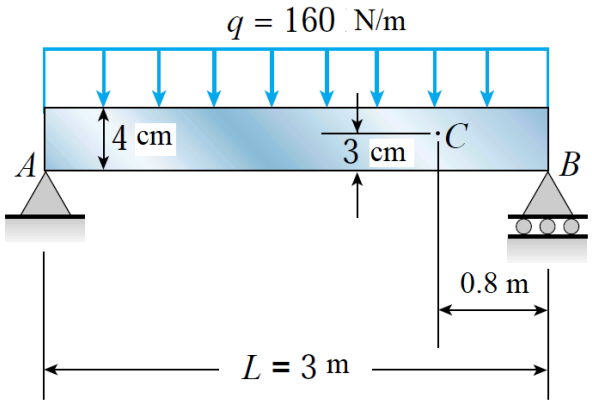
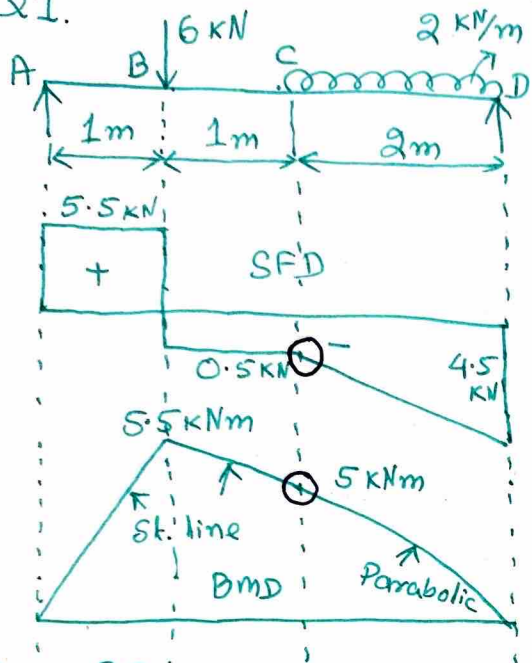
	 Fig. No. 3			
4.	A metal beam with span $L = 3$ m is simply supported at points A and B (figure 4. a). The uniform load on the beam (including its own weight) is $q = 160$ N/m. The cross section of the beam is rectangular (Fig. 4.b) with width $b = 10$ mm. and height $h = 40$ mm. The beam is adequately supported against sideways buckling. Determine the normal stress σ_C and shear stress τ_C at point C, which is located 10 mm below the top of the beam and 800 mm from the right-hand support. Show these stresses on a sketch of a stress element at point C.  Fig. No. 4 (a)	10	3	5

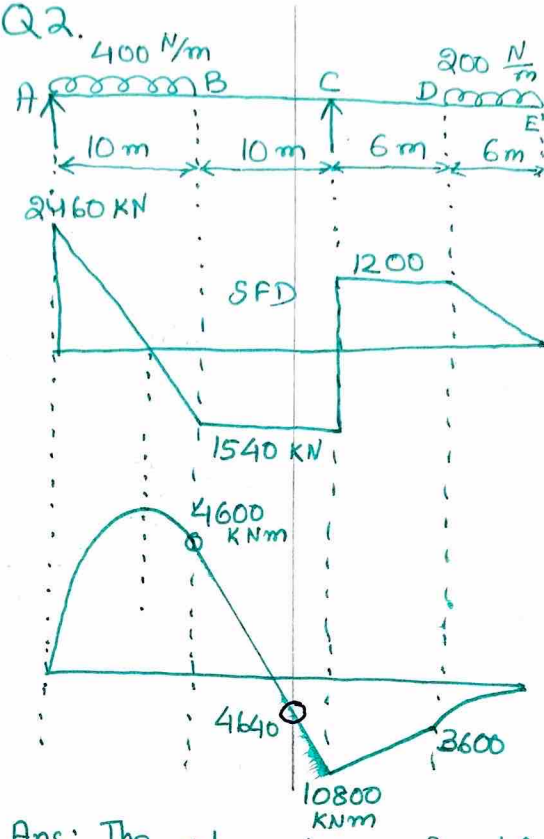
KEY CAT-II, C2 Slot

Q1.



Ans: SF at C = 0.5 kN
BM at C = 5 kNm
Both the answers are marked in the above diagram.

Q2.



Ans: The values at 16 m from left end from A
SF = 1540 kN
BM = 4640 kNm
Both the values are marked in the above figure.

Q3. $M_{max} = 30$ kNm, $\sigma_{b_{wood}} = 15$ MPa

(a) WOOD:

Section modulus $Z_1 = \frac{\pi}{32} d_1^3 = \frac{M_{max}}{\sigma_{allow}}$

$\Rightarrow d_1 = 273$ mm

(b) ALUMINUM: $I_2 = \frac{\pi}{64}\left[d_2^4 - (0.75 d_2)^4\right] = 0.03356\, d_2^4$

$$Z_2 = \frac{I_2}{y} = \frac{0.03356\, d_2^4}{d_2/2} = 0.06712\, d_2^3$$

$$= \frac{M_{max}}{\sigma_{allow\,AL}} = \frac{30 \text{ kNm}}{50 \text{ MPa}} = 600 \times 10^3 \text{ mm}^3$$

$\Rightarrow 600 \times 10^3 = 0.06712\, d_2^3 \Rightarrow d_2 = 207.5$ mm

Q4. At point C

$M_c = 140.8 \times 10^3$ N-mm, $SF_c = F = 112$ N

$$I = \frac{bd^3}{12} = \frac{10 \times 40^3}{12} = 53333 \text{ mm}^4$$

(a) Normal stress

$$\sigma_c = \frac{M_c}{I_{NA}} \times y_c = \frac{140.8 \times 10^3}{53333} \times 10$$

$$= 26.4 \text{ N/mm}^2$$

(b) $$\tau_c = \frac{F A \bar{y}}{I_{NA} \cdot b} = \frac{112 \times (10 \times 10)(15)}{53333 \times 10}$$

$$= 0.315 \text{ N/m}^2$$

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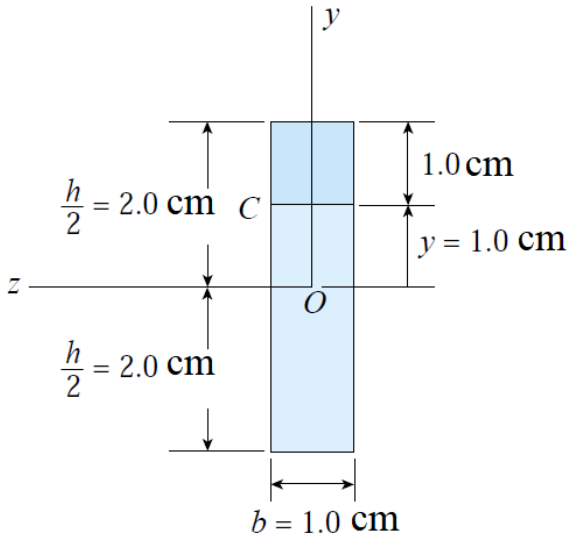
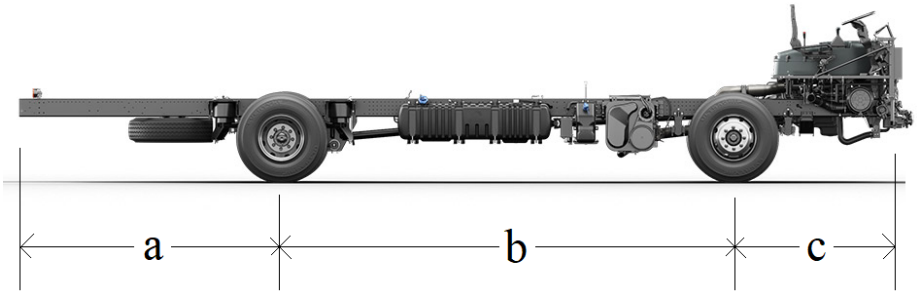
	 Fig. No. 4(b)			
5.	Explain the positioning of the front wheel and back wheel (Fig. 5) in the chassis of the bus based on the magnitude of bending moment values as it was discussed in the 8th module guest lecture dealing with contemporary issues.  Fig. No. 5	10	2	2