



B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2023

(Regulation 2018)

Third Semester

AUTOMOBILE ENGINEERING

U18AUI3202: Strength of Materials

COURSE OUTCOMES

- CO1:** Estimate the strength of various structural elements subjected to different loading conditions.
CO2: Analyze the different types of beams.
CO3: Demonstrate the approaches to calculate slope and deflection of beams.
CO4: Analyze the shafts and columns with different edge conditions by using different theories.
CO5: Interpret the concepts and theories to design pressure vessels.
CO6: Examine the mechanical properties of materials.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

- | | | |
|--|-----|-------------------|
| 1. Define Principal planes and Principal Stress. | CO1 | [K ₁] |
| 2. State Hooke's law and highlight its significance. | CO1 | [K ₂] |
| 3. What are the assumptions made in the theory of simple bending? | CO2 | [K ₂] |
| 4. Draw sketches to show sagging bending moment and hogging bending moment. Also indicate a point of contraflexure in a bending moment diagram | CO2 | [K ₂] |
| 5. What are the advantages of moment–area methods over the double integration method and Macaulay's method? | CO3 | [K ₁] |
| 6. What is Propped Cantilever Beam? Highlight the advantage of it when it is compared with simply supported beam. | CO3 | [K ₂] |
| 7. Hollow circular shafts are preferred over solid shafts – Justify. | CO4 | [K ₂] |
| 8. Give the expression for the slope and deflection of a cantilever beam with a point load at its free end. | CO4 | [K ₁] |
| 9. What is meant by crippling load? | CO6 | [K ₁] |
| 10. The thin-walled cylindrical pressure vessels are designed for hoop stress – Justify. | CO5 | [K ₁] |

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11. A mild steel specimen as shown in Fig.1 is subjected to tensile test in an universal testing machine, as per British Standard 18 procedure. Sketch the typical load extension curve that would be obtained for the mild steel specimen as a result of the test. Also, elaborate the various regions of the load-extension curve. 16 CO1 [K₂]

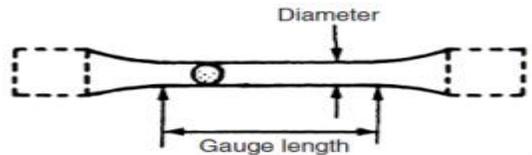
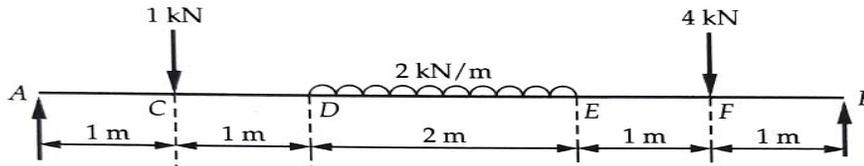


Fig.1

12. Draw the shear force and bending moment diagrams for the simply supported beam 16 CO2 [K₄]



shown in Fig.2.

Fig.2

13. Derive an expression for the slope and deflection of a simply supported beam subjected to uniformly distributed load. 16 CO3 [K₄]

14. The horizontal shaft AD is attached to a fixed base at D and is subjected to the torques shown. A 44-mm-diameter hole has been drilled into portion CD of the shaft. The entire shaft is made of steel for which $G = 77 \text{ GPa}$, Determine the angle of twist at end A. 16 CO4 [K4]

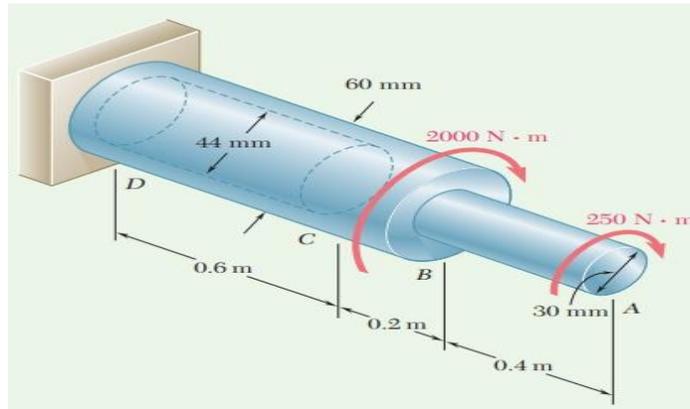
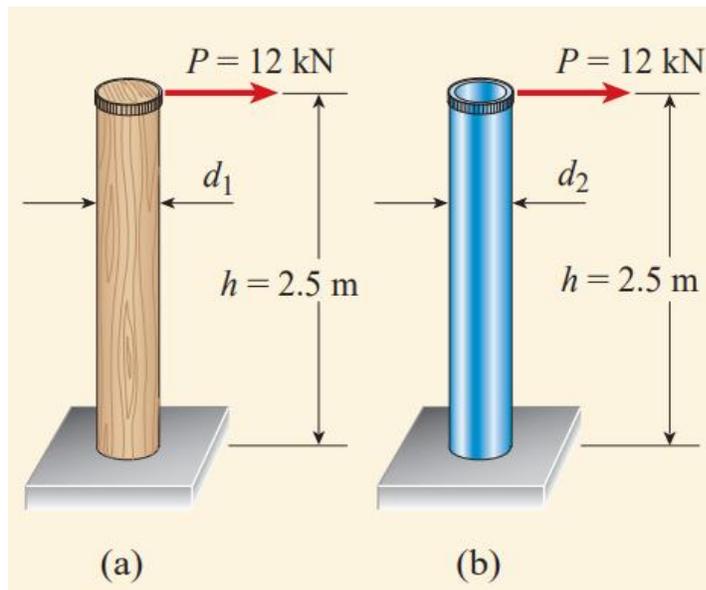


Fig.3

15. A thin cylinder, 3.5 m long, 90 cm in diameter and the thickness of metal is 12 mm it is subjected to an internal pressure of 2.8 N/mm^2 . Calculate the change in dimensions of the cylinder, circumferential and hoops stress, and the maximum intensity of shear stress induced. Given, $E = 200 \text{ GPa}$ and Poisson's ratio = 0.3. 16 CO5 [K3]
16. A vertical post 2.5-meters high must support a lateral load $P = 12 \text{ kN}$ at its upper End. Two plans are proposed—a solid wood post and a hollow aluminum tube. Refer Fig.4 16 CO6 [K5]
- (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?



(a) Solid wood post, and (b) aluminum tube

Fig.4
