

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

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Course Code

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Third Semester B.E. Degree Examinations, January 2025

MECHANICS OF MATERIALS

Duration: 3 hrs

Max. Marks: 100

Note: 1. Answer any FIVE full questions choosing ONE full Question from each Module.
2. Missing data, if any, may be suitably assumed

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO:PI)</u>
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Module-1

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|----|----|--|----|-----------------|
| 1. | a. | Define stress, strain and Modulus of Elasticity. State Hooke's Law. | 10 | (1 : 1 : 1.2.1) |
| | b. | A stepped bar is subjected to an external loading as shown in Fig.Q1 (b). Calculate the change in the length of bar. Take $E_{\text{steel}} = 200 \times 10^3 \text{ N/mm}^2$, $E_{\text{Al}} = 70 \times 10^3 \text{ N/mm}^2$, $E_{\text{copper}} = 100 \times 10^3 \text{ N/mm}^2$ | 10 | (2 : 1 : 2.4.1) |

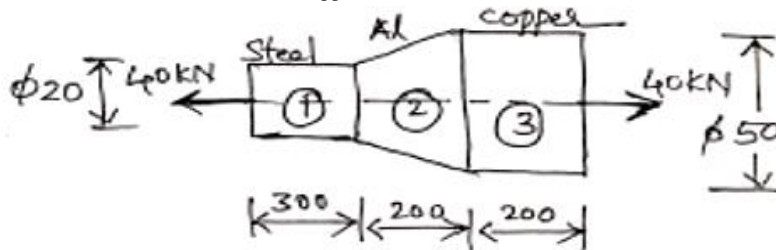


Fig.Q1 (b)

(OR)

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|----|----|--|----|-----------------|
| 2. | a. | Derive an expression for the deformation of a tapered circular body subjected to an axial load | 10 | (1 : 1 : 1.3.1) |
| | b. | A steel bar of cross-section area 200 mm^2 is loaded as shown in Fig. Q2 (b). Find the change in the length of the bar. Take $E_{\text{steel}} = 200 \times 10^3 \text{ N/mm}^2$ | 10 | (2 : 1 : 2.4.1) |

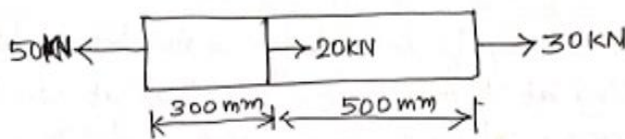


Fig. Q2 (b)

Module-2

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|----|----|---|----|-----------------|
| 3. | a. | Define and explain briefly principal stress and principal strain. | 08 | (1 : 2 : 1.2.1) |
| | b. | Derive an expression for analytical method for determining stresses on oblique section by considering member subjected to direct stress in one plane. | 12 | (2 : 2 : 2.4.1) |

(OR)

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|----|----|--|----|-----------------|
| 4. | a. | Derive an expression for hoop stress and longitudinal stress in a thin cylinder. | 10 | (1 : 2 : 1.2.1) |
|----|----|--|----|-----------------|

- b. A thin cylindrical shell is 1m in diameter and 3 m long has a metal thickness of 10 mm. It is subjected to an internal fluid pressure of 3 N/mm². Determine the changes in diameter, length and volume. Assume Poisson's ratio of 0.3 and $E = 210 \times 10^3 \text{ N/mm}^2$ 10 (2 : 2 : 1.2.1)

Module-3

5. a. Explain the different types of beams with a neat sketch. 08 (1 : 3 : 1.2.1)
- b. A cantilever beam carries point loads and UDL as shown in the Fig. Q5 (b). Draw the SFD and BMD. 12 (2 : 3 : 2.4.1)

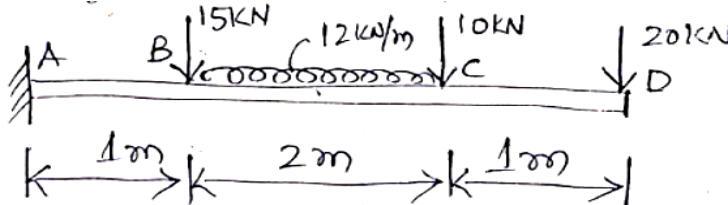


Fig. Q5 (b)

(OR)

6. a. List the assumptions made in the theory of simple bending. 05 (1 : 3 : 1.2.1)
- b. Derive the relationship between moment, bending stress and radius of curvature. 15 (2 : 3 : 2.4.1)

Module-4

7. a. Derive an expression for the cantilever beam subjected to moment at free end. 10 (1 : 4 : 1.4.1)
- b. Derive an expression for the simply supported beam subjected to uniformly distributed load. 10 (2 : 4 : 1.4.1)

(OR)

8. a. Derive the torsional equation in the standard form $\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$. 10 (1 : 4 : 1.4.1)
- b. Calculate the maximum intensity of shear stress in solid shaft 150 mm diameter, transmitting 150 kW at 180 rpm. 10 (2 : 4 : 2.4.1)

Module-5

9. a. Derive the Euler's crippling load for a column when both ends are hinged or pinned. 10 (1 : 5 : 1.4.1)
- b. A 2 m long pin ended column of square cross-section is to be made of wood. Assuming $E=12 \text{ GPa}$ and allowable stress being limited to 12 MPa, Determine the size of column to support the following loads safely. (i) 95 kN (ii) 200 kN. Use factor of safety as 3. 10 (2 : 5 : 2.4.1)

(OR)

- 10 a. Define (i) strain energy (ii) Modulus of resilience (iii) Castigliano's theorem I (iv) Toughness (v) Castigliano's theorem II 12 (1 : 5 : 1.2.1)
- b. Derive an expression for strain energy due to shear stress. 08 (2 : 5 : 1.4.1)

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