

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, September 2024

STRENGTH 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. | Derive an expression for the deformation of circular tapering bar subjected to an axial force. | 10 | (1 : 1 : 1.4.1) |
| | b. | A member is subjected to point loads P_1, P_2, P_3 and P_4 as shown in Fig Q 1(b). Calculate the force P_2 necessary for equilibrium, if $P_1= 45$ kN, $P_3=450$ kN and $P_4= 130$ kN. Determine total elongation in the member. Take modulus of elasticity is 2.1×10^5 N/mm ² . | 10 | (3 : 1 : 2.2.4) |

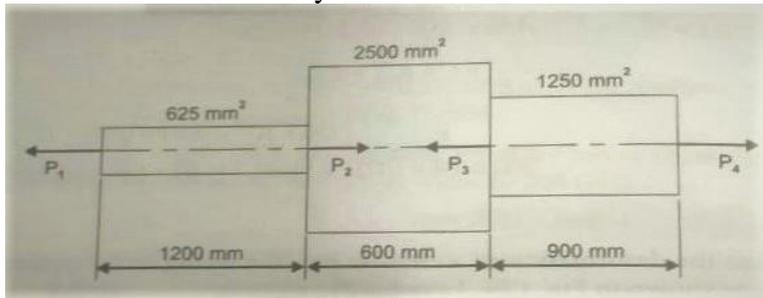


Fig Q 1(b)

OR

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|----|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----------------|
| 2. | a. | Derive the relationship between Young's modulus and modulus of rigidity with usual notation. | 10 | (1 : 1 : 1.4.1) |
| | b. | Three bars of equal length rigidity connected at their ends as shown in Fig Q 2(b). Find the stresses induced in the member and load shared by each member. | 10 | (3 : 1 : 2.2.4) |

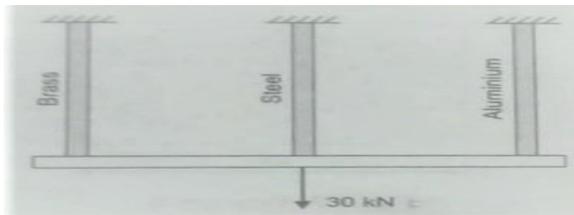


Fig Q 2(b)

Module-2

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|----|----|-------------------------------------------------------------------------------------------------|----|-----------------|
| 3. | a. | Derive the relationship between load intensity, shear force and bending moment. | 10 | (1 : 2 : 1.4.1) |
| | b. | For the cantilever beam as shown in the Fig Q3(b), draw shear force and bending moment diagram. | 10 | (3 : 2 : 2.2.4) |

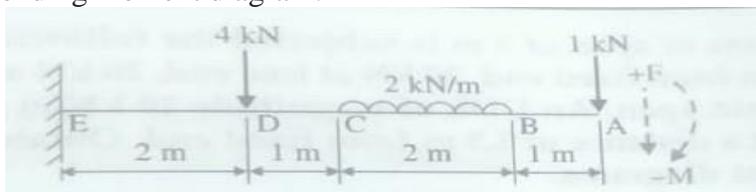


Fig Q3 (b)

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI- Performance Indicator)

OR

4. a. Derive an expression for shear force and bending moment of a simply supported beam carrying a UDL of w/m length throughout its span with neat sketch. **10** (1 : 2 : 1.4.1)
- b. Draw BMD and SFD for the overhanging beam shown in Fig Q 4(b) clearly indicate the point of contra flexure. **10** (3 : 2 : 2.2.4)

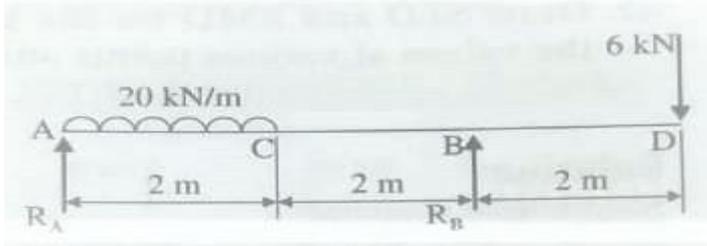


Fig Q 4(b).

Module-3

5. a. Derive the bending Stress equations with usual notations. **10** (1 : 3 : 1.4.1)
- b. A cast iron beam of T section is shown in Fig Q 5(b). The beam is simply supported on a span of 8 m. The beam carries a UDL of 1.5 kN/m length over the entire span. Determine the maximum tensile and compressive stresses. **10** (3 : 3 : 2.2.4)

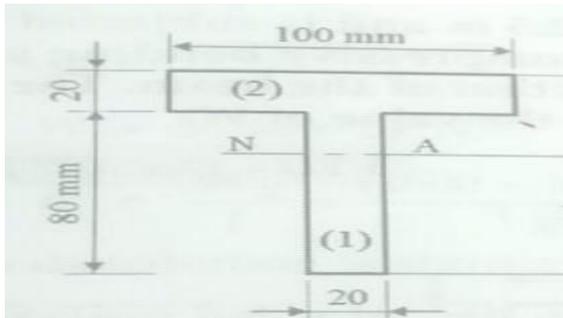


Fig Q 5(b)

OR

6. a. Derive the Expression of the shear stress intensity for rectangular section. **10** (1 : 3 : 1.4.1)
- b. The T section shown in Fig Q 6(b) is subjected to a shear force of 100 kN. Draw shear stress distribution diagram and find the maximum shear stress. **10** (3 : 3 : 2.2.4)

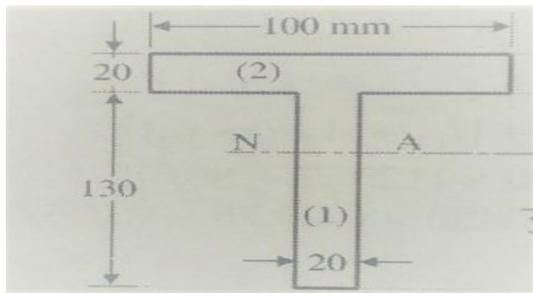


Fig Q 6(b)

Module-4

7. a. Derive torsion equations $\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$ with usual notations. **10** (1 : 4 : 1.4.1)
- b. A hollow circular shaft has to transmit 300 kW power at 80 rpm. If the shear stress is not exceed 60 N/mm^2 and the internal diameter is 0.6 times the outer diameter, find the external and internal diameters, assuming that the maximum torque is 1.4 times the mean. **10** (3 : 4 : 2.2.4)

OR

8. a. Derive the expression for principle stress and principle plane of 2D-stress system. **10** (1 :4 : 1.4.1)
- b. A rectangular block of material is subjected to a tensile stress of 100 N/mm² on one plane and tensile stress of 47 N/mm² on the plane at right angle to the first as shown in Fig Q 8(b), each of the above stresses is accompanied by shear stress of 63 N/mm². Determine the magnitude and direction of each principal stress and magnitude of shear stress. **10** (3 :4 : 2.2.4)

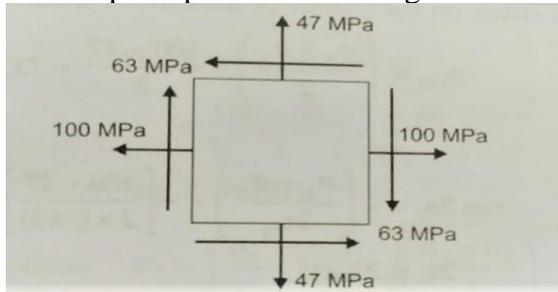


Fig Q 8(b)

Module-5

9. a. Derive the expression for Euler's buckling load for a column with both ends are hinged. **10** (1 :5 : 1.4.1)
- b. A hollow C.I column whose outer diameter is 200 mm as a thickness of 20 mm. It is 4.5 m long and fixed at both ends. Calculate the safe load by Rankine's formula using a factor of safety 0.4. Calculate the slenderness ratio and ratio of Euler's and Rankine's critical loads. Take $E = 9.4 \times 10^4 \text{ N/mm}^2$, $\alpha = 1/1600$, $\sigma_c = 550 \text{ MPa}$. **10** (3 :5 : 2.2.4)

OR

- 10 a. Derive the Expression for moment curvature equation. **10** (1 :5 : 1.4.1)
- b. Determine the deflection under the loads in the beam shown in Fig Q 10(b). Take flexural rigidity as EI, throughout. **10** (3 :5 : 2.2.4)

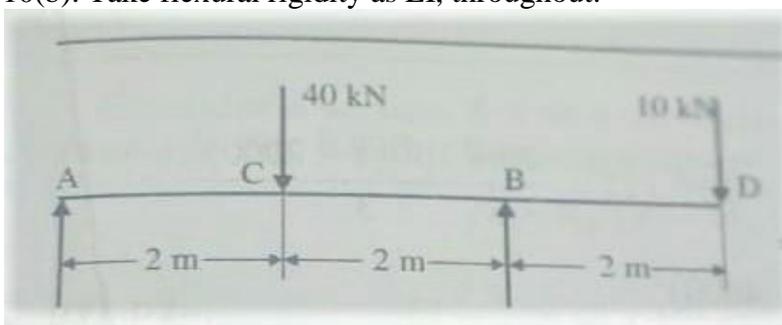


Fig Q 10(b)

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