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Course Code

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Third Semester B.E. Degree Examinations, March/April 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>
<u>Module-1</u>			
1.	a. Derive an expression for elongation of circular tapering bar subjected to an axial pull P.	08	(1:1:1.3.1)
	b. The following data refers to mild steel specimen tested in a laboratory. Diameter of specimen = 24 mm; Gauge length = 200 mm; Extension under load 100 kN = 0.04 mm; Yield point load = 150 kN; Maximum load = 225 kN; Neck diameter = 18.2 mm; Load at failure = 275 kN, length at failure = 275 mm. Determine (i) Young's modulus; (ii) Yield stress (iii) Ultimate stress (iv) percentage elongation.	12	(2:1:1.3.1)
(OR)			
2.	a. Derive the relation between modulus of rigidity (shear modulus) and modulus of elasticity	08	(1:1:1.3.1)
	b. A load of 600 kN is applied on a reinforced concrete column of size 300 mm × 500 mm. The column is reinforced with 6 bars of steel of 10 mm diameter. Find the stress developed in steel and concrete. Take $E_s = 15E_c$.	12	(2:1:1.3.1)
<u>Module-2</u>			
3.	a. Derive the relation between intensity of load, shear force and bending moment.	08	(1:2:1.3.1)
	b. Draw the SF and BM diagrams indicating principal values for an overhanging beam shown in Fig. Q3(b). Locate the point of contra flexure if any	12	(2:2:1.3.1)
			
OR			
4.	a. Draw the SF and BM diagrams for a simply supported beam carrying UDL over the entire span.	08	(1:2:1.3.1)
	b. A simply supported beam of span 6 m is subjected to a concentrated load of 25 kN acting at a distance of 2 m from the left end. It is also subjected to a UDL of 10 kN/m over the entire span. Draw the SFD and BMD indicating the maximum and minimum values.	12	(2:2:1.3.1)
<u>Module-3</u>			
5.	a. Derive Bernoulli's bending stress equation.	08	(1:3:1.3.1)

- b. A cantilever of square section 200 mm × 200 mm, 2 m long just fails in flexure when loaded of 12 kN is placed at its free end. A beam of the same material and having a rectangular cross section 150 mm wide and 300 mm deep is simply supported over a span of 3 m. Calculate the minimum central point load to break the beam. **12** (2:3:1.3.1)

(OR)

6. a. Prove that the maximum traverse shear stress is 1.5 times the average shear stress in beam of rectangular cross section. Plot the shear stress distribution. **08** (1:3:1.3.1)
- b. A simply supported beam of T section as shown in Fig. Q6 (b) is subjected to bending moment of 12 kN-m. Determine the maximum tensile and compressive stress. Also draw the bending stress distribution diagram. **12** (2:3:1.3.1)

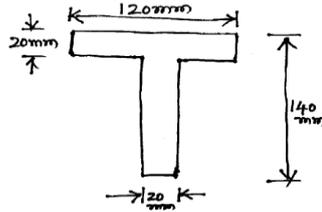


Fig. Q6(b)

Module-4

7. a. Derive the torsion equation $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$ with usual notations. **08** (1:4:1.3.1)
- b. A solid circular shaft has to transmit power of 1000 kW at 120 rpm. Find the diameter of the shaft if the shear stress of the material is not to exceed 80N/mm². The maximum torque is 1.25 times the mean torque. What percentage saving in material should be obtained if the shaft is replaced by hallow one whose inner diameter is 0.6 times the external diameter, the length, material and maximum shear stress being same. **12** (2:4:1.3.1)
- (OR)
8. a. Show that the principal planes and maximum shearing planes are inclined at 45° with each other. **08** (1:4:1.3.1)
- b. Direct stresses of 120 MPa tension and 90 MPa compression are applied to an elastic material at a centre point on the planes at right angles. The maximum principal stress is limited to 150 MPa. What is the corresponding shear stress on the given planes and what will be the maximum shearing stress at that point? **12** (2:4:1.3.1)

Module-5

9. a. With usual notations derive $EI \frac{d^2 y}{dx^2} = M$ **08** (1:5:1.3.1)
- b. A simply supported steel beam having uniform cross section is 14 m span and is simply supported at its ends. It carries a concentrated load of 120 kN and 80 kN at two points 3 m and 4.5 m from left and right end respectively. If the moment of inertia of the section is 160 × 10⁷ mm⁴ and E=210 GPa, calculate the deflection of the beam at load points. **12** (2:5:1.3.1)
- (OR)
10. a. Derive the Euler's equation for buckling load on a column with both ends hinged. **08** (1:5:1.3.1)
- b. Find the Euler's crippling load for a hallow cylindrical steel column of 40 mm diameter and 4 mm thick. Take the length of column as 2.3 m and column is hinged at both ends. Also determine the crippling load by Rankine's formula using constants as 335 MPa and 1/75000. Take E=205 × 10³N/mm². **12** (2:5:1.3.1)

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