CBCS SCHEME

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BCV301

Third Semester B.E./B.Tech. Degree Examination, June/July 2024

Strength of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

<table>
<tr><th colspan="3">Module – 1</th><th>M</th><th>L</th><th>C</th></tr>
<tr><td>Q.1</td><td>a.</td><td>A rod of length 'L' tapers uniformly from a diameter 'D' at one end to a diameter 'd' at the other. Derive the expression for the extension caused by an axial load 'P' the material has Young's modulus of Elasticity 'E'.</td><td>10</td><td>L3</td><td>CO1</td></tr>
<tr><td></td><td>b.</td><td>A specimen of 15mm diameter and 200mm long is subjected to tensile test and data at proportional and elastic limits were recorded as below.
<table>
<tr><th>Limit</th><th>Stress (MPa)</th><th>Increase in length (mm)</th><th>Reduction in diameter (mm)</th></tr>
<tr><td>Proportional</td><td>340</td><td>0.90</td><td>?</td></tr>
<tr><td>Elastic</td><td>350</td><td>1.00</td><td>0.0225</td></tr>
</table>
Find modulus of Elasticity, Poisson's ratio and the reduction in diameter.</td><td>10</td><td>L3</td><td>CO1</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.2</td><td>a.</td><td>A steel bar is 4 m long and its both ends are firmly fixed to two walls. The original temperature of the bar is 40°C. If the bar is cooled to 25°C, determine the thermal strain and stress in the bar. Assume $E_s = 200$ kN/mm^2 and $\alpha_s = 12\times10^{-6}$ per °C. State the nature of stress set up.</td><td>10</td><td>L3</td><td>CO1</td></tr>
<tr><td></td><td>b.</td><td>A structural member 5m long is made up of two materials as shown in Fig.Q2(b). The bar is in tension under load 'P' and the total Elongation of the bar is 0.1 cm. Determine (i) The magnitude of the load (ii) The work done is Elongation of the bar. Take $E_s = 210$ GPa and $E_b = 84$ GPa.

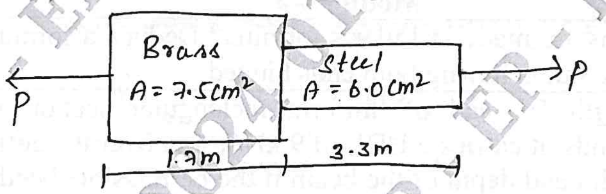


Fig.Q2(b)</td><td>10</td><td>L3</td><td>CO1</td></tr>
<tr><th colspan="6">Module – 2</th></tr>
<tr><td>Q.3</td><td>a.</td><td>Derive the relationship between Shear Force and Bending Moment.</td><td>05</td><td>L3</td><td>CO2</td></tr>
<tr><td></td><td>b.</td><td>A Beam of length 10m is simply supported at it ends. It carries a UDL of 20 kN/m run over the length of left half of its span together with concentrated loads of 20 kN, 40 kN and 20 kN situated at 1.5m, 2.5m and 5m respectively from right hand support. Draw the bending moment and shear force diagram. [Refer Fig.Q3(b)]

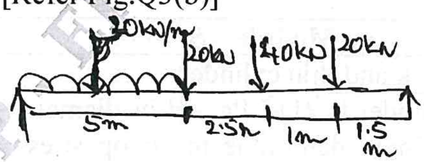
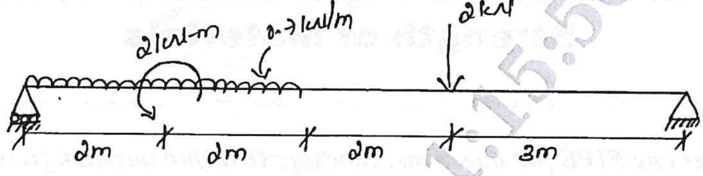
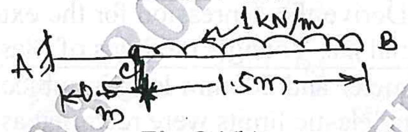


Fig.Q3(b)</td><td>15</td><td>L3</td><td>CO2</td></tr>
</table>

		OR			
Q.4	**a.**	Draw Shear force and Bending moment diagram for the beam shown in Fig.Q4(a) and label the salient values.  Fig.Q4(a)	12	L3	CO2
	b.	A cantilever beam of length 2.0m carries a UDL of 1 kN/m run over a length of 1.5m from free end. Draw the shear force and bending moment diagram for the cantilever. [Refer Fig.Q4(b)]  Fig.Q4(b)	08	L3	CO2
		Module – 3			
Q.5	**a.**	Prove that in case of rectangular section of a beam, the maximum shear stress is 1.5 times average shear stress.	10	L3	CO3
	b.	A hallow shaft is to transmit 300 kW power at 80 rpm. If the shear stress is not to exceed 60 N/mm^2 and the internal diameter is 0.6 times the external diameter, find the external and internal diameter assuming that the minimum torque is 1.4 times the mean.	10	L3	CO3
		OR			
Q.6	**a.**	Derive the equation of pure bending with usual notations.	10	L3	CO3
	b.	A simply supported wooden beam of spam 1.3m having a cross-section 150mm wide and 250mm deep carries a point load 'W' at the centre. The permissible stress are 7 N/mm^2 in bending and 1 N/mm^2 in shearing. Calculate the safe load 'W'.	10	L3	CO3
		Module – 4			
Q.7	**a.**	What assumptions are made in Euler's formula? Deduce a formula for the critical load of a column having both ends hinged.	10	L3	CO4
	b.	A beam of length 5m and of uniform rectangular section is simply supported at its ends. It carries a UDL of 9 kN/m run over the entire length. Calculate the width and depth of the beam if the permissible bending stress is 7 N/mm^2 and the central deflection is not to exceed 1 cm.	10	L4	CO4
		OR			
Q.8	**a.**	For a simply supported beam carrying a point load at the centre. Determine the magnitude of maximum deflection.	10	L3	CO4
	b.	A hollow mild steel tube 6m long and 4 cm internal diameter and 6mm thick is used as a strut. Find the crippling load and safe load taking FoS as 3. Take $E = 2\times10^5$ N/mm^2 when (i) Both ends Hinged (ii) Both Ends Fixed.	10	L3	CO4
		Module – 5			
Q.9	**a.**	Differentiate between thick and thin cylinder.	04	L2	CO5
	b.	Pressure inside a thin cylinder is 2115 Pa and its diameter 1 m. If thickness of the cylinder wall is 5mm, determine the hoop stress and longitudinal stress induced in the cylinder material.	06	L3	CO5
	c.	The tensile stresses at a point across two mutually perpendicular planes are 120 N/mm^2 and 60 N/mm^2. Determine the normal, tangential and resultant stresses on a plane inclined at 30° to the axis of minor stress.	10	L3	CO5

		OR			
Q.10	a.	A point in a strained material possesses principal stresses of 600 N/mm^2 (tensile) and 400 N/mm^2 (compressive). Draw Mohr's stress circle and determine the following on an oblique plane, inclined at 40° with the plane of the major principal stress: i) Normal stress ii) Shear stress iii) Maximum shear stress iv) Resultant stress	10	L3	CO5
	b.	The external and internal diameter of a thick cylinder are respectively 800mm and 400mm. The cylinder is subjected to an external and internal fluid pressure of 100 GPa and 10 GPa. Determine the maximum hoop stress induced in the shell material.	10	L3	CO5

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