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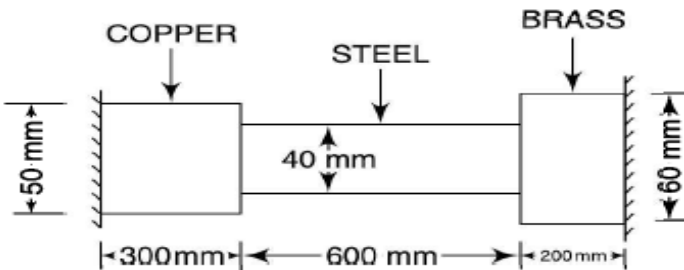
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**BTECH**  
**(SEM V) THEORY EXAMINATION 2023-24**  
**STRENGTH OF MATERIAL**

**TIME: 3 HRS****M.MARKS: 100****Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.**SECTION A****1. Attempt all questions in brief.**

Q no.	Question	Marks	CO
a.	Briefly explain Poisson's ratio and Bulk modulus.	2	1
b.	What is impact load and write formula for impact stress?	2	1
c.	Why the strain at the common interface is equal in a composite beam?	2	2
d.	What is the importance of section modulus of a beam?	2	2
e.	What is spring? What are different types of spring?	2	3
f.	State the effect of eccentric loading on short column.	2	3
g.	What is 'Shrinkage allowance' in compound cylinders?	2	4
h.	In case of gas as a fluid, which type of container will be used to contain the fluid?	2	4
i.	Briefly explain unsymmetrical bending.	2	5
j.	What assumptions are taken in the analysis of shear center in beams?	2	5

**SECTION B****2. Attempt any three of the following:**

a.	<p>A composite bar made up of copper, steel and brass is rigidly attached to the end supports as shown in figure.</p>  <p>Determine the stresses in the three portions of the bar when the temperature of the composite system is raised by 70°C if</p> <p>(i) The supports are rigid</p> <p>(ii) The supports yield by 0.6 mm</p> <p>Take <math>E_c = 100 \text{ GPa}</math>, <math>E_s = 205 \text{ GPa}</math>, <math>E_b = 95 \text{ GPa}</math>, <math>\alpha_c = 18 \times 10^{-6}/^\circ\text{C}</math>, <math>\alpha_s = 11 \times 10^{-6}/^\circ\text{C}</math> and <math>\alpha_b = 19 \times 10^{-6}/^\circ\text{C}</math>.</p>	10	1
b.	Derive the relation of torsional equation of shaft.	10	2
c.	<p>Using Euler's formula, determine the critical stresses for a strut of slenderness ratio 80, 120, 160 and 200 under the condition of</p> <p>(i) Both ends hinged,</p> <p>(ii) Both ends fixed.</p> <p>Take <math>E = 205 \text{ GPa}</math>.</p>	10	3
d.	<p>Wall thickness of a cylindrical shell of 800-mm internal diameter and 2-m long is 10 mm. If the shell is subjected to an internal pressure of 1.5 MPa, find the following:</p> <p>(1) The maximum intensity of shear stress induced</p> <p>(2) The change in dimensions of the shell</p>	10	4



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	Take $E = 205 \text{ GPa}$ , Poisson's ratio = 0.3		
e.	With the help of Winkler batch theory, derive the value of factor $h_2$ for: (i) Circular section (ii) Triangular section	10	5

**SECTION C****3. Attempt any one part of the following:**

a.	For a given loading conditions the state of stress in the wall of a cylinder is expressed as follows : (i) $85 \text{ MN/m}^2$ tensile, (ii) $25 \text{ MN/m}^2$ tensile at right angles to (i), and (iii) Shear stresses of $60 \text{ MN/m}^2$ on the planes on which the stresses (i) and (ii) act; the shear couple acting on planes carrying the $25 \text{ MN/m}^2$ stress is clockwise in effect. Calculate principal stresses and principal planes.	10	1
b.	The load on a bolt consists of an axial pull of 20 kN together with a transverse shear of 10 kN, Calculate the diameter of bolt according to : (i) Maximum total strain energy theory, and (ii) Maximum shear strain energy theory. Take elastic limit in tension 280 MPa, factor of safety=3 and Poisson's ratio = 0.3	10	1

**4. Attempt any one part of the following:**

a.	A timber beam 80 mm wide and 160 mm deep is reinforced with two steel plates 5 mm thick and 60 mm wide on top and bottom. If bending moment of 800 N-m acts at section of this beam, calculate the magnitude of maximum fiber stresses in tensions and compression in wood and steel. Assume $E_s/E_w = 15$ .	10	2
b.	Compare hollow shaft and solid shaft. (i) On the basis of Strength. (ii) On the basis of weight.	10	2

**5. Attempt any one part of the following:**

a.	What assumptions are made in the analysis of columns by Euler's buckling theory? Derive an expression for Euler's crippling load when both ends of column are hinged.	10	3
b.	A closed-coiled helical spring having 24 turns is made of 8-mm diameter wire. The mean diameter of the spring is 80 mm and it carries a load of 250 N. Determine the shear stress developed, the deflection and the stiffness of the spring. Take, $G = 84 \text{ GPa}$ .	10	3

**6. Attempt any one part of the following:**

a.	Deduce the general equations for circumferential and radial stresses developed in thick cylinders along with assumptions.	10	4
b.	A steel tube of 120-mm external diameter is shrunk on another steel tube of 48-mm internal diameter. After shrinking, the diameter at the junction is 80 mm. Initial difference of diameters at the junction before shrinking was 0.04 mm. Determine	10	4



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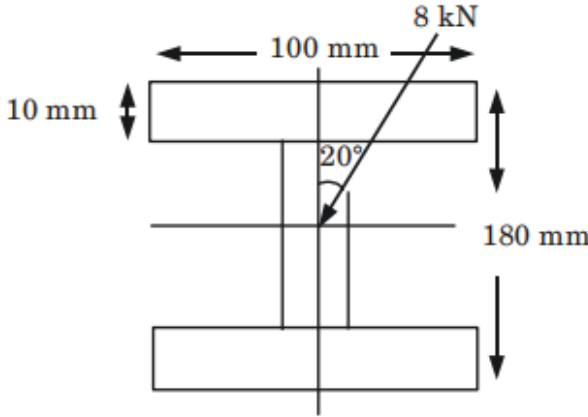
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	(i) Radial pressure at the junction, (ii) Hoop stress developed in the two tubes after the shrinking. Take $E = 210 \text{ GPa}$		
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**7. Attempt any one part of the following:**

a.	<p>A simply supported I-section beam of span 1.5 m carries a concentrated load of 8 kN at an angle of <math>20^\circ</math> from vertical as shown in Figure. Load passes through the centroid of the section. Determine the maximum bending stress in the beam.</p> 	10	5
b.	Briefly discuss shear centre along with examples. Prove that sum of moment of inertia about any set of rectangular axis is constant.	10	5