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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.

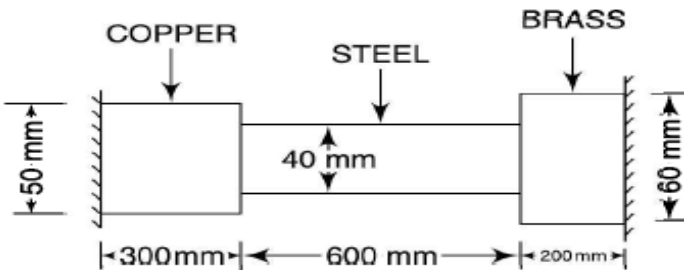
SECTION A

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 $E_c = 100\text{GPa}$, $E_s = 205\text{GPa}$, $E_b = 95\text{GPa}$, $\alpha_c = 18 \times 10^{-6}/^\circ\text{C}$, $\alpha_s = 11 \times 10^{-6}/^\circ\text{C}$ and $\alpha_b = 19 \times 10^{-6}/^\circ\text{C}$.</p>	10	1
b.	Derive the relation of torsional equation of shaft.	10	2
c.	Using Euler's formula, determine the critical stresses for a strut of slenderness ratio 80, 120, 160 and 200 under the condition of	10	3
	(i) Both ends hinged, (ii) Both ends fixed. Take $E = 205\text{GPa}$.		
d.	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:	10	4
	(1) The maximum intensity of shear stress induced (2) The change in dimensions of the shell		



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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 MN/m^2 tensile, (ii) 25 MN/m^2 tensile at right angles to (i), and (iii) Shear stresses of 60 MN/m^2 on the planes on which the stresses (i) and (ii) act; the shear couple acting on planes carrying the 25 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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	(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.	A simply supported I-section beam of span 1.5 m carries a concentrated load of 8 kN at an angle of 20° from vertical as shown in Figure. Load passes through the centroid of the section. Determine the maximum bending stress in the beam.	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

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