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**BTECH**  
**(SEM IV) THEORY EXAMINATION 2023-24**  
**ENGINEERING MECHANICS & STRENGTH MATERIAL**

**TIME: 3 HRS****M.MARKS: 70****Note:** Attempt all Sections. If require any missing data; then choose suitably.**SECTION A****1. Attempt all questions in brief.****2 x 7 = 14**

|    |                                                 |
|----|-------------------------------------------------|
| a. | What are the conditions of equilibrium.         |
| b. | What is a cantilever truss?                     |
| c. | Define principal planes and principal stresses. |
| d. | Define thermal stress and strain.               |
| e. | What is bending stresses?                       |
| f. | Define slenderness ratio.                       |
| g. | What are the criteria for thin cylinder shell?  |

**SECTION B****2. Attempt any three of the following:****7 x 3 = 21**

|    |                                                                                                                                                           |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| a. | State and prove parallelogram law of forces.                                                                                                              |
| b. | State and prove the theorem of perpendicular axis applied to moment of inertia.                                                                           |
| c. | Define torsion of shaft. Derive an expression for torsion equation of solid circular shaft subjected to torque T.                                         |
| d. | Derive an expression for the Euler's crippling load for a long column with both ends are fixed.                                                           |
| e. | What are the effects on the dimensions of thin cylindrical shell subjected in internal fluid pressure? Derive an expression for its change in dimensions. |

**SECTION C****3. Attempt any one part of the following:****7 x 1 = 7**

|    |                                                                                                                                       |
|----|---------------------------------------------------------------------------------------------------------------------------------------|
| a. | <p>Determine the forces in the members of the truss shown in Fig.</p>                                                                 |
| b. | <p>Draw the S.F. and B.M. diagrams of a simply supported beam of length 7 m carrying uniformly distributed loads as shown in Fig.</p> |



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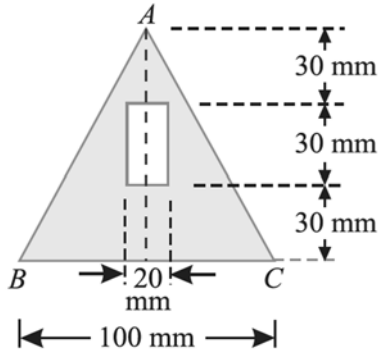
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**4. Attempt any one part of the following:****7 x 1 = 7**

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                       |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| a. | A rectangular hole is made in a section as shown in Fig. Determine of inertia of the section about X-X through its center of gravity and the                                                                                                                                                                                                                                                                                                                         |  <p>triangular the moment axis passing base BC.</p> |
| b. | A plane element in a boiler is subjected to tensile stresses of 400 MPa on one plane and 150 MPa on the other at right angle to the former. Each of the above stresses is accompanied by a shear stress of 100 MPa such that when associated with the major tensile stress tends to rotate the element in an anticlockwise direction. Find (a) Principal stresses and their directions, (b) Maximum shearing stresses and directions of the plane on which they act. |                                                                                                                                       |

**5. Attempt any one part of the following:****7 x 1 = 7**

|    |                                                                                                                                                                                                                       |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a. | Determine the slope and deflection of simply supported beam of length $l$ subjected a uniformly distributed load $w$ over the length of beam by Macaulay's method.                                                    |
| b. | A solid steel shaft has to transmit 100 kW at 160 r.p.m. Taking allowable shear stress as 70 MPa, find the suitable diameter of the shaft. The maximum torque transmitted in each revolution exceeds the mean by 20%. |

**6. Attempt any one part of the following:****7 x 1 = 7**

|    |                                                                                                                                                                                                                                                                                                     |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a. | Drive an expression for bending stresses of leaf spring of span length $l$ , width $b$ , thickness $t$ , number of plates $n$ , subjected to load $w$ .                                                                                                                                             |
| b. | Find the Euler's crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm thick. Take length of the column as 2.3 m and hinged at its both ends. Take $E = 205$ GPa. Also determine crippling load by Rankine's formula using constants as 335 MPa and $1/7500$ . |

**7. Attempt any one part of the following:****7 x 1 = 7**

|    |                                                                                                                                                                                                                                                                                                         |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a. | A cast iron pipe of 400 mm internal diameter and 100 mm thickness carries water under a pressure of $8 \text{ N/mm}^2$ . Determine the maximum and minimum intensities of hoop stress across the section. Also sketch the radial pressure distribution and hoop stress distribution across the section. |
| b. | A cylindrical shell of 500 mm diameter is required to withstand an internal pressure of 4 MPa. Find the minimum thickness of the shell, if maximum tensile strength in the plate material is 400 MPa and efficiency of the joints is 65%. Take factor of safety as 5.                                   |