Roll No. ..... **Total No. of Pages : 03**

Total No. of Questions : 09

B.Tech.(AE) (Sem.–3)

MECHANICS OF MATERIALS

Subject Code : AE-201

Paper ID : [A0701]

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTION TO CANDIDATES :

1. **SECTION-A is COMPULSORY.**
2. **Attempt any FOUR questions from SECTION-B.**
3. **Attempt any TWO questions from SECTION-C.**

SECTION-A (10 × 2 = 20 Marks)

1. (a) Define Poisson's ratio.

   (b) List the assumptions taken in the development of theory of simple bending.

   (c) What is the difference between a closed and an open helical spring ?

   (d) Define Buckling factor.

   (e) Why are spherical pressure vessels preferred over cylindrical shapes?

   (f) What is 'Wahl factor" used in analysis of springs ?

   (g) State Castigiliano's theorem.

   (h) Draw the variation of shear stress in a circular shaft under torsion.

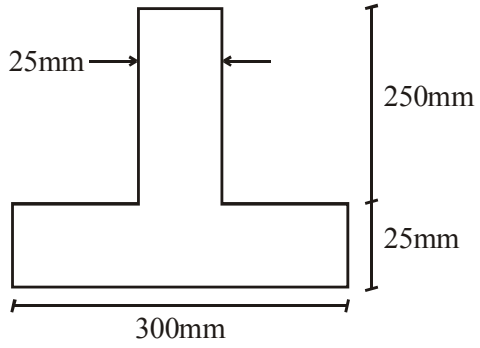
   (i) What is the difference between a strut and a column?

   (j) Write the expression of strain energy in a beam due to torsion.

SECTION-B **(4 × 5 = 20 Marks)**

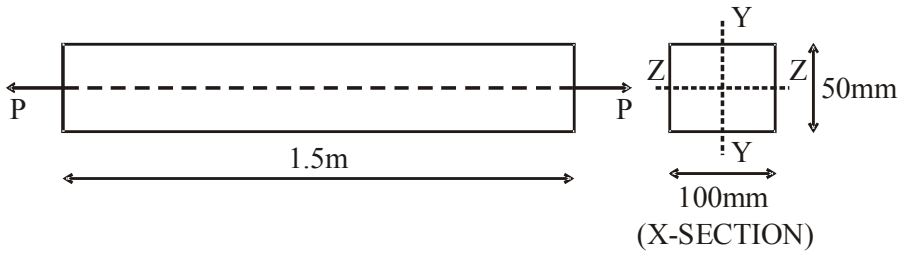
2. Derive the expression of critical load for a column of length L, with both ends fixed.

3. Plot the shear stress distribution along the cross section of the beam shown below, which is subjected to a shear force of 20 *kN*.



4. Derive the expression for slope and deflection for a simply supported beam of length *l*. The beam is subjected to a pure couple at a distance '*a*' from the left end support. Any method can be used for the derivation.

5. A bar made of steel has the dimensions shown in the figure. If an axial force P = 80*kN* is applied to the bar, determine the change in its length and the change in the dimensions of its cross-section after applying the load. The material behaves elastically. E for steel = 200 GPa and Poisson's ratio = 0.32



6. Derive the expression for-stresses in a thin cylindrical vessel of mean radius R and wall thickness *h*, subjected to internal pressure *p*.

SECTION-C **(2 × 10 = 20 Marks)**

7. A solid alloy shaft 50*mm* in diameter is to be coupled in series with a hollow steel shaft of the same external diameter. Find the internal diameter of the steel shaft if the angle of twist per unit length of steel shaft is to be 75% of that of the alloy shaft. Also determine the speed at which the shafts are to be driven to transmit 200kW, if the limits of the shearing stresses are to be 55*MP*a and 75*MP*a for alloy and steel, respectively. $G_{Steel} = 2.2\ G_{Alloy}$.

8. Two parallel but out-of-plumb walls 6m apart are stayed together by a steel rod of 25*mm* diameter at a temperature of 78°C passing through steel plates, washers and nuts on outer side of the wall at each end . Determine the pull exerted by the rod when it is cooled to 24°C, for

   (a) if the walls do not yield, and

   (b) if the walls yield at two ends by 2*mm*. Young's Modulus for steel = 200*GP*a and coefficient of thermal expansion for steel = $11x\ 10^{-6}$/°C.

9. Draw the shear force and bending moment diagrams for the beam shown below. Write down the equations for shear force and bending moments as a function of x, where (1.2m ≤ x ≤ 3m). Also show salient points on the diagrams along with their values.