Roll No. | | | | | | | | | | |

# ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

## B.E / B. Tech (Full Time) END SEMESTER EXAMINATIONS – APRIL / MAY 2025

MECHANICAL ENGINEERING

**CE295 Strength of Materials**

**(R2004)**

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

## PART- A (10 x 2 = 20 Marks)

| Q.No | Questions | Marks |
|---|---|---|
| 1. | What is a principal plane? | 2 |
| 2. | Explain with sketches, the failures observed in thin cylinders. | 2 |
| 3. | Give the simple bending equation and explain the terms. | 2 |
| 4. | Draw the stress distribution of a symmetrical 'I' section. | 2 |
| 5. | What are the assumptions made in the theory of torsion. | 2 |
| 6. | Differentiate between the behavior of leaf and helical springs. | 2 |
| 7. | Draw the conjugate beam for a cantilever beam of length 'L' m subjected to a concentrated load of 'W' kN at the free end. | 2 |
| 8. | What are the limitations of area moment theorem? | 2 |
| 9. | State the Engessor's theorem. | 2 |
| 10. | Define proof resilience. | 2 |

## PART- B (5 x 16 = 80 Marks)

(Q. No 11 is Compulsory)

| Q.No | Questions | Marks |
|---|---|---|
| 11. | A 4 m long simply supported beam carries a uniformly distributed load of 5 kN/m and 10 kN/m on the left half and right half of the beam respectively. Draw the shear force and bending moment diagram. Also find the maximum bending moment induced in the beam. | 16 |
| 12. | a) A steel bar of 25 mm diameter passes through a brass sleeve of internal diameter 28 mm and external diameter 32 mm; the ends being rigidly fastened together. Initial length of the composite bar is 500 mm. Calculate the stresses in each material and elongation of the bar if it is subjected to a tensile load of 100 kN. Take Young's modulus of steel and brass as $200x10^3$ N/mm$^2$ and $90x10^3$ N/mm$^2$ respectively. | 16 |
| | OR | |
| | b) A metal bar 50 mm x 40 mm thick in section is subjected to an axial compression of 600 kN. Contraction was found to be 0.75 mm for length of 300 mm whereas increase in thickness was 0.05 mm. Find the value of Poisson's ratio and also the Young's modulus (E), Bulk Modulus (K) and Rigidity modulus (G)? | 16 |

| | | |
|---|---|---|
| 13. | a) Determine the diameter of a solid shaft which will transmit 330 kW at 300 rpm. The angle of twist must not exceed one degree in a 2 m length shaft nor the maximum shear stress 40 $MN/m^2$. Take the value of rigidity modulus as 84 $kN/mm^2$. | 16 |
| | OR | |
| | b) A closed coil helical spring is made with 7.5 mm diameter wire and is having a mean diameter of 80 mm and 10 complete turns. The modulus of rigidity of the material of the spring is 80 $x10^3$ $N/mm^2$. When a load of 120 N is applied, determine the maximum shear stress, strain energy stored, deflection produced and stiffness of the spring. | 16 |
| 14. | a) A beam of constant cross section 6 m long is freely supported at the ends. It is loaded at points 2 m from each end with a concentrated load of 20 kN. Find the slope at the left support and deflection under the load. Also find the maximum deflection. Take flexural rigidity as 'EI'. | 16 |
| | OR | |
| | b) A 6 m simply supported beam is carrying a uniformly distributed load of 25 kN/m over its entire span and two point loads of 15 kN at 1.5 m from both the ends. Find the slope at the left support, deflection under the load and the maximum deflection, using moment area method. Take Young's modulus 'E' as 200 $kN/mm^2$ and moment of inertia 'I' as $332x10^6$ $mm^4$. | 16 |
| 15. | a) Determine the deflection and the slope at the free end of a cantilever with uniformly distributed load on the whole span using Castigliano second theorem. | 16 |
| | OR | |
| | b) (i) State and Derive the Maxwell's Reciprocal Theorem.<br>(ii) A bar 1000 mm in length is subjected is subjected to an axial pull, such that the maximum stress is equal to 150 $N/mm^2$. Its area of cross section is 200 $mm^2$ over a length of 950 mm and for the middle 50 mm length it is only 100 $mm^2$. If the Young's modulus 'E' is 200 $kN/mm^2$, calculate the strain energy stored in the bar. | 6<br>10 |