

B.Tech. Degree III Semester Examination, November 2009

CE/EE 303 STRENGTH OF MATERIALS (2006 Scheme)

Time: 3 Hours

Maximum Marks: 100

PART - A (Answer *ALL* question)

(8 x 5 = 40)

- I.
- (a) What is meant by normal stress and shear stress? What are the effects of normal stress and shear stress on a body?
 - (b) Calculate the change in length of a tapering bar of circular cross-section with length, 'L', diameters at the ends, 'd₁' and 'd₂', subjected to an axial tensile force of 'P', if Hooke's law is obeyed.
 - (c) What are the assumptions made in the torsion theory of circular shafts? What is the nature of stress due to torsion in circular shafts?
 - (d) Derive the relation among shear force, bending moment and intensity of loading in a beam.
 - (e) What is 'section modulus' in connection with bending of beams? Compare the section moduli of a rectangular (depth=twice width), square and circular sections having equal area.
 - (f) Explain briefly the meaning of principal stresses. If the state of stress in an interior element of a body is pure shear (τ), what are the principal stresses (consider two-dimensional case).
 - (g) Calculate the deflection and slope at the free end of a cantilever beam subjected to a concentrated load, 'P' at a distance of 'a' from the fixed end. The total span of the cantilever is '(a+b)'.
 - (h) Derive the Euler's formula for critical buckling load of a column of length, 'L' fixed at one end and free at the other.

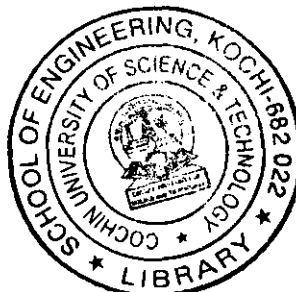
PART - B (All questions carry equal marks)

(4 x 15 = 60)

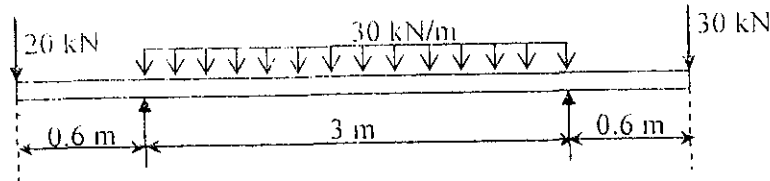
- II. (a) A 25mm diameter bar is subjected to an axial tensile load of 100 kN. Under the action of this load a 200mm gauge length is found to extend 0.19mm. Determine the modulus of elasticity for the bar material. (b) If, in order to reduce weight whilst keeping the external diameter constant, the bar is bored axially to produce a cylinder of uniform thickness, what is the maximum diameter of bore possible given that the maximum allowable stress is 240 N/mm²? The load can be assumed to remain constant at 100 kN. (c) What will be the change in the outside diameter of the bar under the limiting stress quoted in (b) if $\nu = 0.3$.
- OR**
- III. A 75mm diameter compound bar is constructed by shrinking a circular brass bush onto the outside of a 50mm diameter solid steel rod. If the compound bar is then subjected to an axial compressive load of 160 kN, determine the load carried by the steel rod and the brass bush and the compressive stress set up in each material. For steel, $E = 2.1 \times 10^5$ N/mm², for brass, $E = 1 \times 10^5$ N/mm².
- IV. A bar of mild steel 25 mm diameter twists 2 degrees in a length of 250mm under a torque of 430 Nm. The same bar deflects 0.8mm when simply supported at each end horizontally over a span of 500mm and loaded at the center of the span with a vertical load of 1.2 kN. Calculate the values of the three elastic moduli and Poisson's ratio ν for the material.

OR

(Turn Over)



- V. Sketch the S.F. and B.M. diagrams for the beam shown in the following figure and hence determine the position of any points of contraflexure.

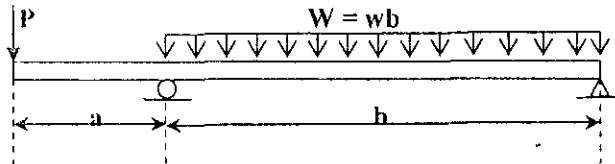


- VI. A uniform T-section beam is 100mm wide and 150mm deep with a flange thickness of 25mm and a web thickness of 12mm. If the limiting bending stresses for the material of the beam are 80 N/mm^2 in compression and 160 N/mm^2 in tension, find the maximum intensity of uniformly distributed load that the beam can carry over a simply supported span of 5m

OR

- VII. A material is subjected to a horizontal tensile stress of 90 N/mm^2 and a vertical tensile stress of 120 N/mm^2 , together with shear stresses of 75 N/mm^2 , those on the 120 N/mm^2 planes being counter-clockwise in effect. Determine: (a) the principal stresses (b) the maximum shear stress (c) the shear stress which, acting alone would produce the same maximum principal stress and (d) the tensile stress which, acting alone, would produce the same maximum shear stress.

- VIII.



A simply supported beam with overhang is loaded as shown in the figure. If $a = b/2$, find the ratio P/W to make the deflection under the load P equal to zero.

OR

- IX. A steel bar of rectangular cross-section $2.5 \text{ cm} \times 5 \text{ cm}$ is to be used as a column. What is the shortest length for which Euler's equation applies if $E = 2.1 \times 10^5 \text{ N/mm}^2$ and stress at limit of proportionality is 210 N/mm^2 for the following end conditions: (a) both ends pinned (b) both ends built-in (c) one end built-in and the other end pinned and (d) one end built-in and the other end free. Also calculate the critical compressive stress for the column if it is 1.2 m long, for the end conditions mentioned above.
