THE OPEN UNIVERSITY OF SRI LANKA
Department of Civil Engineering
Bachelor of Technology - Level 3

CEX 3234 – Strength of materials

FINAL EXAMINATION - 2015

Time Allowed : Three (03)hours

Date : 2014 - 08 - 24 (Monday) Time : 0930 - 1230 hrs.

The paper consists of Eight *(08)* questions. Answer any *Five (05)* questions.

Q1. (a) Prove that the volumetric strain of a cylindrical rod which is subjected to an axial tensile load is equal to strain in the length minus twice the strain of diameter.

(b) A bar of cross –section 8 mm x 8 mm is subjected to an axial pull of 7000 N. The lateral dimension of the bar is found to be changed to 7.9985 mm x 7.9985 mm. If the modulus of rigidity of the material is 8.0 x 10^4 N/mm^2, determine the Poisson's ratio and modulus of elasticity.

(20 marks)

Q2. (a)A body is subjected to direct stresses in two mutually perpendicular directions. How will you determine graphically the resultant stress on an oblique plane when the stresses are unequal and unlike (ie. one is tensile and the other is compressive).

(b) An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N / mm^2 on these planes. Draw the Mohr's circle of stresses and hence determine;

(i) the magnitudes
(ii) the directions of principal stress.

(20 marks)

Q3.

(a) What do you mean by point of contraflexure?
(b) How many points of contraflexure you will have for simply supported beam overhanging at one end only?
(c) A Simplify supported beam of length 10m, carries a uniformly distributed load and two point loads as shown in FigQ.3. Draw the shear force and bending moment diagram for the beam. Also calculate the maximum bending moment.

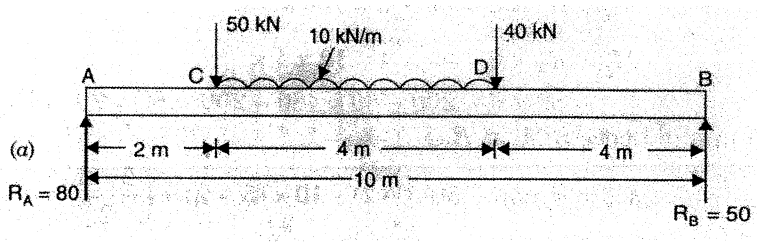


Fig.Q-3

(20 marks)

Q4.

(a) What do you mean by 'simple bending' or 'pure bending'? What are the assumptions made in the theory of simple bending?

(b) State the simple bending formula. Write the meanings of the terms of simple bending formula and state units of all the terms.

(c) A square beam 20 mm x 20 mm in section and 2 m long is supported at the ends. The beam

fails when a point load of 400N is applied at the centre of the beam. What uniformly distributed load per meter length will break a cantilever of the same material 40 mm wide, 60 mm deep and 3m length?

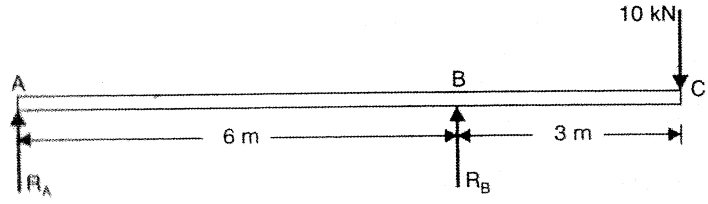
(20 marks)

Q5.

(a) Prove that the deflection at the centre of a simply supported beam, carrying a point load at the centre, is given by $y_c = \frac{WL^3}{48EI}$

Where W = point load, L = Length of the beam.

(b) An overhanging beam ABC is loaded as shown in Fig Q-5. Find the slope over each support and at the right end.



FigQ-5

(20 marks)

Q6. (a) Define the terms,

(i) Torsion
(ii) Torsional rigidity
(iii) Polar moment of inertia

(c) A hollow shaft of diameter ratio 3/8 (internal diameter to outer diameter) is to transmit 375kw power at 100 r.p.m. The maximum torque being 20% greater than the mean. The shear stress is not to exceed 60 N/mm^2 and twist in a length of 4 m not to exceed 2°. Calculate its external and internal diameter which would satisfy both the above conditions. Assume modulus of rigidity is 8.5 x 10^4 N/mm^2.

(20 marks)

Q7. (a) Explain how the failure of a short and of a long column takes place?

(b) What is equivalent `length of a column? How is the concept used in the column theory?

(c) A column of timber section 15 cm x 20 cm is 6 metre long both ends being fixed. If the; Young's modulus for timber = 17.5 kN/mm^2, determine;

(i) Crippling load
(ii) Safe load for the column if factor of safety = 3

(20 marks)

Q8. (a) Define the terms;

(i) Elasticity
(ii) Elastic limit
(iii) Young's modulus
(iv) Modulus of Rigidity

(b) Three sections of a bar are having different lengths and different diameters. The bar is subjected to an axial load P. Determine the total change in length of the bar. Take Young's modulus of different sections same.

(c) The ultimate stress, for a hollow steel column which carries and axial load of 1.9 MN is 480N/mm^2. If the external diameter of the column is 200 mm, determine the internal diameter. Take the factor of safety as 4.

(20 marks)