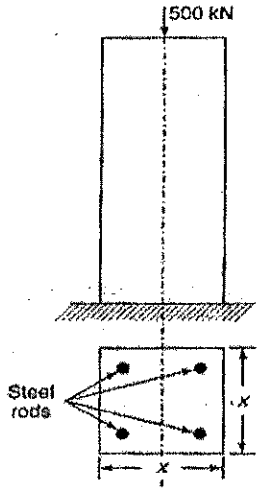
THE OPEN UNIVERSITY OF SRI LANKA
Bachelor of Technology - Level 3
CEX 3234 - Strength of Materials
Final Examination - 2016/2017
Time Allowed 3 hours

16th November 2017 Time - 13.30 - 16.30 hrs

Answer any Five questions. All the questions carry equal marks.

Q1. (a) Explain factor of safety and Poisson's ratio.

(b) A reinforced concrete column has a square cross-section. It is reinforced with 4 steel rods of diameter 20 mm at each corner. The column carries an axial compressive load of 500 kN. Find the required size of the column so that the stress in the concrete does not exceed 4 N/mm². Find also the load carried by steel and the stress induced in it. Assume ratio between modules of Elasticities of steel and concrete, $\frac{E_s}{E_c} = 15$.

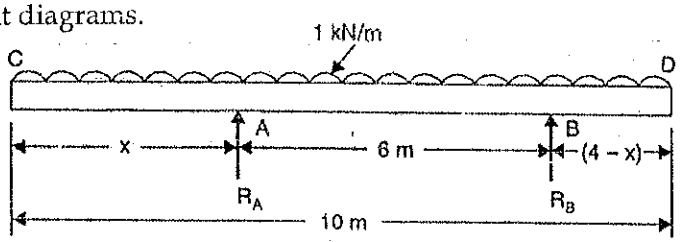


Q2. Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 30 mm and of length 1.5 m if the longitudinal strain in a bar during a tensile stress is four times the lateral strain. Find the change in volume, when the bar is subjected to a hydrostatic pressure of 100 N/mm². Take E = 1 x 10⁵ N/mm².

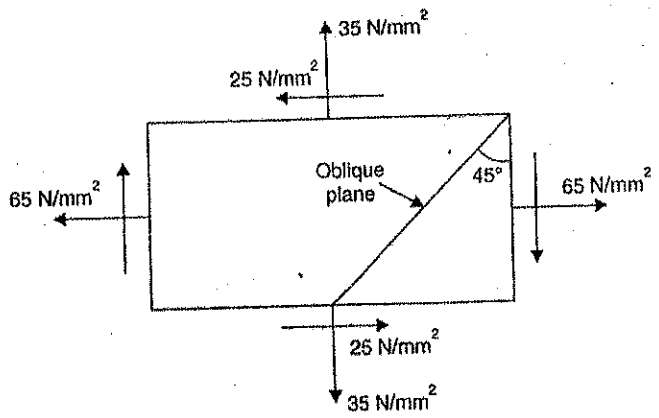
Q3. (a) Torsion formula for a circular section can be written as $\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{r}$. Explain the meanings of each term and write the relevant units of each term. Also state the assumptions you are making when deriving the Torsion formula.

(b) A 100 mm diameter shaft transmitting power, rotates at 30 Hz. It is subjected to bending loads that produce a bending moment of 2500p N.m. If the maximum shearing stress and maximum normal stress that the shaft can withstand are 80 N/mm², and 100 N/mm² respectively, determine the torque that can act simultaneously on the shaft. What is the maximum power that can be transmitted by the shaft.

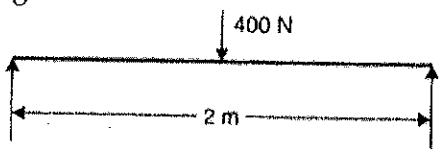
Q4. A horizontal beam 10 m long is carrying a uniformly distributed load of 1 kN/m. The beam is supported on two supports 6 m apart. Find the position of the supports so that Bending Moment on the beam is as small as possible. Also draw the Shear Force and Bending Moment diagrams.

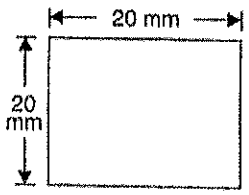


Q5. A point in a strained material is subjected to stresses shown in Figure. Using Mohr's circle method, determine the normal and tangential stresses across the oblique plane. Check the answers analytically.

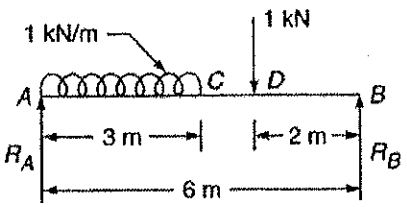


Q6. A square beam 20 mm x 20 mm in section and 2 m long is supported at the ends. The beam fails when a point load of 400 N is applied at the centre of the beam. What uniformly distributed load per meter length will break a cantilever of the same material 40 mm wide, 60 mm deep and 3 m long?





Q7. A simply supported beam is loaded as shown in Figure. Determine the deflection at points C and D in the beam. Take E = 200 GPa and I = 2000 cm⁴.



Q8. Determine the ratio of buckling strengths of two columns, one hollow and the other solid. Both are made of the same material and have the same length, cross-sectional area and end conditions. The internal diameter of hollow column is half of its external diameter.

Buckling Load of a column as given by Euler's formula, $p = \frac{\pi^2 EI}{L^2}$.