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

CEX 3234 – Strength of materials

FINAL EXAMINATION - 2013

Time Allowed : **Three (03)hours**

Date : 2014 - 08 - 11 (Monday) Time : 0930 - 1230 hrs.

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

Q1. A horizontal beam 10m long is carrying a uniformly distributed load of 1kN/m. The beam is supported on two supports 6m apart.

(i) Draw the free body diagram

(ii) Find the position of the supports, so that bending moment on the beam is as small as possible. .

(iii) Draw the bending moment and shear force diagrams for (ii) above stating the sign convention clearly.

Q2. Calculate the maximum stress induced in a cast iron pipe of external diameter 40mm, internal diameter 20mm and length 4m, when the pipe is supported at its ends and carries a point load of 80N at its centre.

Q3. A square beam 20mmx20mm in section and 2m long is supported at the ends. The beam fails when a point load of 400N is applied at the center of the beam. What uniformly distributed load for meter length will break a cantilever of the same material 40mm wide, 60mm deep and 3m long?

Q4. (a) Explain the following terms

(i) Radius of gyration

(ii) Slenderness ratio

(b) 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 areas and end conditions**. The internal diameter of hollow column is half of its external diameter.

Q5. A beam of length 6m is simply supported at its ends and carries two point loads of 48kN and 40kN at a distance of 1m and 3m respectively from the left support. Find,

1. Deflection under each load

2. Maximum deflection, and

3. The point at which maximum deflection occurs.

Given $E=2x10^5$ N/mm^2 and $I=85x10^6$ mm^4 .

Q6. (a) State the Torsion formula and state the units of all the terms.

(b) A hollow shaft, having an internal diameter 40% of its external diameter, transmits 562.5kW power at 100 r.p.m. Determine the external diameter of the shaft if the shear stress is not to exceed 60N/mm^2 and the twist in a length of 2.5m should not exceed 1.3 degrees. Assume maximum torque=1.25xmean torque and modules of rigidity =$9x10^4$N/mm^2

Q7. (a) (i) Explain the terms of the formula, E=2G(1+v).

(ii) A square bar of cross-section 8mmx8mm is subjected to an axial pull of 7000N. The lateral dimension of the bar is found to be changed to 7.9985mmx7.9985mm. If the modulus of rigidity of the material is $0.8x10^5$ N/mm^2, determine the Poisson's ratio and modulus of elasticity.

(b) A reinforced concrete column, 4m high has the cross-section of 400mm x 400mm. The four reinforcing bars are each 20mm in diameter. If the column is subjected to 1000kN compressive force, find the stresses in steel bars and concrete, and shortening of the column. Take Young's modulus of steel and concrete to be, 200kN/mm^2 and 15 kN/mm^2 respectively .

Q8. (a) Explain the following terms.

(i) Principal plane

(ii) Principal stress

(b) At a point in a strained material, the principal stresses are 200N/mm^2 tensile and 40 N/mm^2 compressive. Determine the resultant stress in magnitude and direction on a plane inclined at 60^0 to the axis of the major principal stress. What is the maximum intensity of shear stress in the material at the point?

(c) At a certain point in a strained material, the intensities of stress on two planes at right angles to each other are 20N/mm^2 and 10N/mm^2 both tensile. They are accompanied by a shear stress of magnitude 10N/mm^2. Find graphically, the location of principal planes and evaluate the principal stresses.