THE OPEN UNIVERSITY OF SRI LANKA
Faculty of Engineering Technology
Department of Civil Engineering
Bachelor of Technology Honours (Civil Engineering) - Level 3

CVX3442 - Strength of Materials

FINAL EXAMINATION – 2021/2022

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

Date: 2023-02-06 (Monday) Time: 1330 - 1630 hrs.

Paper consists of seven (07) questions. Answer any five (05) questions. This is a 'Closed Book Test' (CBT). You should read the questions carefully and answer in clear handwriting.

Q1.

(a) The bar shown in Fig. Q1(a) is subjected to a tensile load of 160 kN. If the stress in the middle portion is limited to 150 N/mm², determine the diameter of the middle portion. Also find the length of the middle portion if the total elongation of the bar is to be 0.2 mm. Young's modulus is given as 2.1×10^5 N/mm².

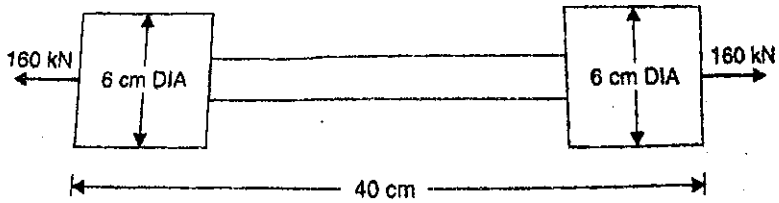

Fig. Q1(a)

(10 marks)

(b) A rigid bar ACDB is hinged at A and supported in a horizontal position by two identical steel wires as shown in Fig. Q1 (b). A vertical load of 30 kN is applied at B. Find the tensile forces T_1 and T_2 induced in these wires by the vertical load.

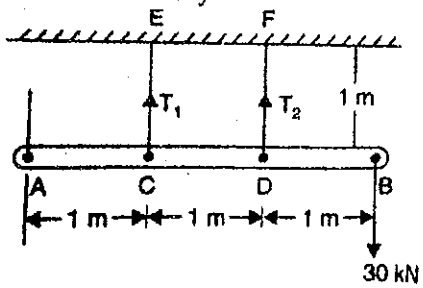

Fig. Q1(b)

(10 marks)

Q2.

(a) Define the terms ;

(i) Principal stress
(ii) Principal plane

(04 marks)

(b) A reinforced short concrete column 250 mm x 250 mm in section is reinforced with 8 steel bars. The total area of steel bars is 2500 mm². The column carries a load of 390 kN. If the modulus of elasticity for steel is 15 times that of concrete, find the stresses in concrete and steel.

(16 marks)

Q3.

(a) Two wooden pieces 10 cm X 10 cm in cross-section are glued together along line AB as shown in Fig. Q3(a) below. What maximum axial force P can be applied if the allowable shearing stress along AB is 1.2 N/mm²?

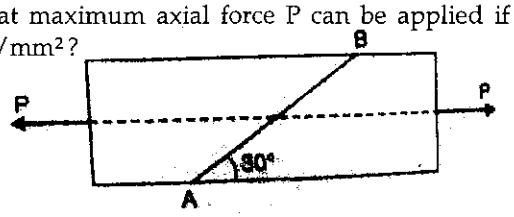

Fig. Q3(a) *(10 marks)*

(b) At a certain point in a strained material, the intensities of stresses on two planes at right angles to each other are 20 N/mm² and 10 N/mm² both tensile. They are accompanied by a shear stress of magnitude 10 N/mm². Find graphically, the location of principal planes and evaluate the principal stresses.

(10 marks)

Q4.

(a) State the sign convention for bending moment and shear force in general.

(02 marks)

(b) 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 B.M. on the beam is as small as possible. Also draw the S.F. and B.M. diagrams.

(18 marks)

Q5.

(a) A beam of length 6 m is simply supported at its ends and carries two point loads of 48 kN and 40 kN at a distance of 1 m and 3 m respectively from the left support. Given that $E = 2 \times 10^5$ N/mm² and $I = 85 \times 10^6$ mm⁴.
Determine;

(i) deflection under each load,
(ii) maximum deflection,
(iii) the point at which maximum deflection occurs.

(12 marks)

(b) Determine the crippling load for a T-section of dimensions 10cm x 10cm x 2cm and of length 5m when it is used as a strut with both of its ends hinged. Take Young's modulus, $E = 2.0 \times 10^5$ N/mm².

(08 marks)

Q6.

(a) State the Torsion Formula. Expalain all tha parameters and express the units of them.

(8 marks)

(b) A solid circular shaft transmits 75 kW power at 200 r.p.m. Calculate the shaft diameter, if the twist in the shaft is not to exceed 1° in 2 metres length of shaft, and shear stress is limited to 50 N/mm². Take $G = 1 \times 10^5$ N/mm².

(12 marks)

Q7.

(a) State the bending formula. Explain all the parameters in brief and write the units of them.

(06 marks)

(b) A square beam 20mm x 20mm in section and 2m 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 metre length will break a cantilever of the same material 40mm wide, 60mm deep and 3m long?

(14 marks)