The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Civil Engineering

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Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: CVX3442 Strength of Materials**
Academic Year	: 2020/2021
Date	: 27th January 2022
Time	: 1400 - 1700hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions in **Three (3)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. This is a Closed Book Test (**CBT**).
6. Answers should be in clear handwriting.
7. Do not use red colour pen.

Q1.

(a) Define the following terms.
   (i) Elasticity
   (ii) Elastic limit
   (iii) Young's Modulus
   (iv) Modulus of rigidity

(Marks 08)

(b) The bar shown in Fig. Q1 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. Find also 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 equal to 2.1×10^5 N/mm².

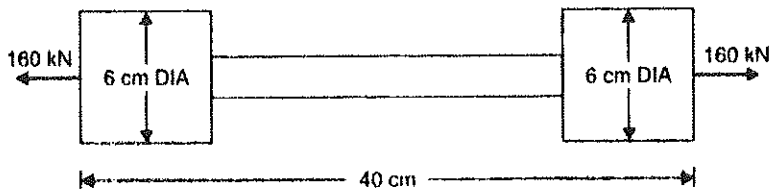

Figure Q1

(Marks 12)

Q2.

(a) Explain briefly the terms "Shear stress" and "Complementary Stress" with proper illustrations.

(Marks 06)

(b) A steel rod 5 m long and 30 mm in diameter is subjected to an axial load of 50 kN. Determine the change in length, diameter and volume of the rod. Take $E = 2 \times 10^5$ N/mm² and Poisson's ratio = 0.25.

(Marks 14)

Q3.

(a) Define the terms principal plane and principal stress.

(Marks 04)

(b) A point in a strained material is subjected to stresses shown in Figure Q3. Using Mohr's circle method, determine the normal and tangential stresses across the oblique plane. Check the answer analytically.

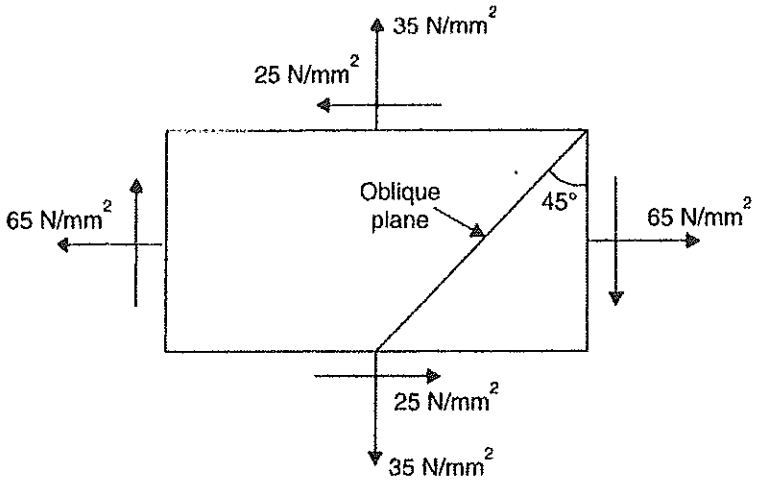

Figure Q3

(Marks 16)

Q4.

(a)

(i) What are the sign conventions for shear force and bending moment in general?

(ii) What do you mean by point of contraflexure? Is the point of contraflexure and point of inflexion different?

(Marks 04)

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

(Marks 16)

Q5.

(a)

(i) What do you mean by "Simple bending". What are the assumptions made in the theory of simple bending.

(ii) State bending equation and explain all the terms in bending equation.

(Marks 08)

(b) A timber beam of rectangular section of length 8 m is simply supported. The beam carries a U.D.L. of 12 kN/m run over the entire length and a point load of 10 kN of 3 metro from the left support. If the depth is two times the width and the stress in the timber is not to exceed 8 N/mm², find the suitable dimensions of the section.

(Marks 12)

Q6.

(a) What is Mecaulay's method? Where is it used?

(Marks 04)

(b) A beam ABC of length 9 m has one support of the left end and the other support at a distance of 6 m from the left end. The beam carries a point load of 1 kN at right end and also carries a uniformly distributed load of 4 kN/m over a length of 3 m as shown in Fig. Q6. Determine the slope and deflection at point C.

Take $E = 2 \times 10^5$ N/mm^2 and $I = 5 \times 10^8$ mm^4

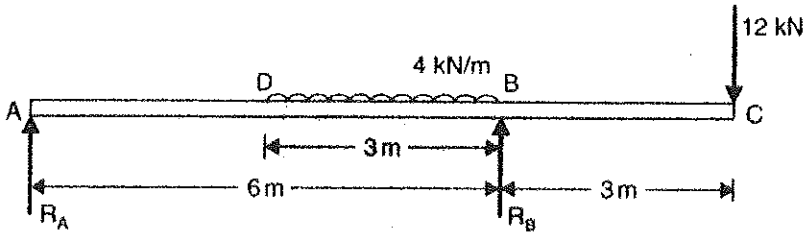

Figure Q6

(Marks 16)

Q7.

(a) State torsion formula and explain all the terms of the torsion formula.

(Marks 06)

(b) A hollow shaft, having an internal diameter 40% of its diameter, transmits 562.5 kW power at 100 r.p.m. Determine the external diameter of the shaft if the shear stress is not to exceed 60 N/mm^2 and the twist in a length of 2.5 m should not exceed 1.3 degrees. Assume maximum torque = 1.25 mean torque and modulus of rigidity = 9×10^4 N/mm^2.

(Marks 14)

Q8.

(a)

(i) Define the terms columns, strut and cripling load.

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

(Marks 06)

(b) Determine Euler's crippling load for an I-section joist 40 cm x 20 cm x 1 cm and 5 m long which is used as a strut with both ends fixed. Take Young's modulus for the joist as 2.1×10^5 N/mm^2.

(Marks 14)