The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Bachelor of Technology Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**DMX4205 Strength of Materials I**
Academic Year	:	2020/21
Date	:	20th January 2022
Time	:	14:00hrs – 17:00hrs
Duration	:	3 hours

General instructions

1. Read instructions given below carefully before answering the questions.
2. This question paper consists of seven (07) questions. Answer any five (05) questions.
3. All questions carry equal marks.

Question No.01:

a) Write down Euler's formula and explain the notations with units. ***(03 marks)***

b) Briefly explain the following terms.
(i) Buckling of columns (ii) Slenderness ratio (iii) Equivalent ***(06 marks)***

c) What is the difference between the 'Strut' and the 'Column'? ***(02 marks)***

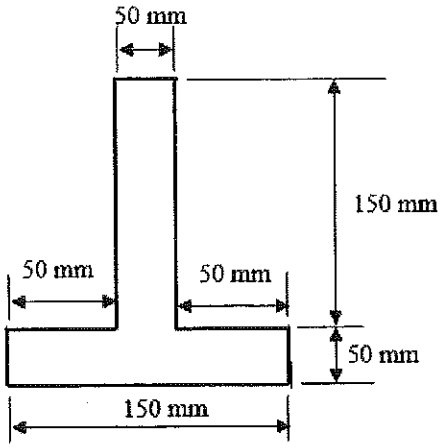

Fig.Q1

A 3m column with both ends, hinged having a cross section as shown in Fig.Q1, is constructed from two pieces of timber, that act as a unit. If the modulus of elasticity of timber is E = 13 GPa. Determine

(i) the slenderness ratio
(ii) critical buckling load
(iii) axial stress in the column when the critical load is applied.

(09 marks)

Question No.02:

a) Define briefly the terms ***principal stress*** and ***principal plane*** in a two dimensional stress system

(04 marks)

b)

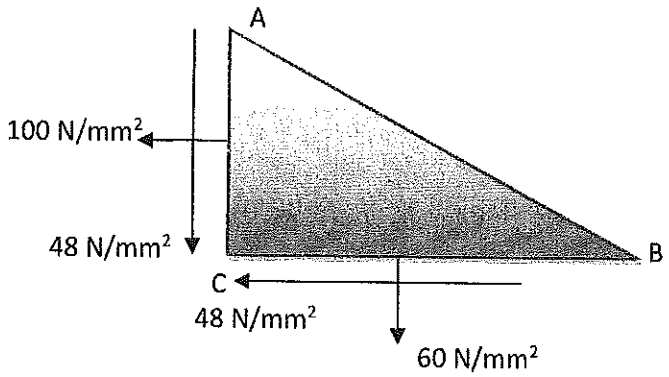

Fig.Q2

The stresses acting on three mutually perpendicular planes at a point in an elastic material are 100N/mm^2 tensile and 48 N/mm^2 shear on plane AC, 60 N/mm^2 tensile and 48 N/mm^2 complementary shear on plane BC, and no stress on plane 3 as shown in Fig.Q2.

i) Construct Mohr's circle according to the stresses given in Fig.Q2. ***(06 marks)***

Hence determine,

ii) the principal stresses ***(04 marks)***

iii) the principal planes. ***(02 marks)***

iv) the maximum shear stress ***(02 marks)***

v) the corresponding normal stress for the maximum shear stress ***(02 marks)***

vi) the stress components exerted on the element obtained by rotating the given element counterclockwise through 30 degrees. ***(04 marks)***

Take Modulus of elasticity 'E' = 200x10^6 N/mm^2 and υ = 0.3.

Question No.03:

A simply supported beam, AB of span 2.5m, is subjected to a uniformly distributed load and a clockwise couple as shown in Fig.Q3.

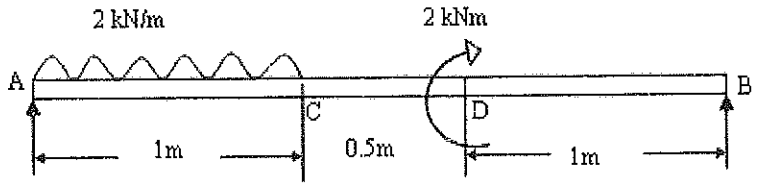

Fig.Q3

a) Draw the shear force and bending moment diagram for the beam AB

(14 marks)

b) Hence find the magnitudes of maximum shear force, maximum bending moment, and their locatons on the beam.

(06 marks)

Question No.04:

The Fig.Q4 shows a cantilever beam of constant flexural rigidity EI, length **L,** fixed at its one end, is subjected to a uniformly distributed load of **w** per unit length.

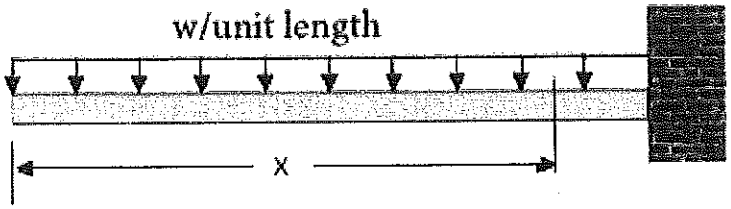

Fig.Q4

a) Draw the free body diagram for the above loading system

(02 marks)

b) Find the equation of elastic curve

(12 marks)

Hence determine

c) the maximum slope of the beam

(03 marks)

d) the maximum deflection of the beam

(03 marks)

Question No.05:

a) List out the characteristics of a strain gauge.

(03 marks)

b) What is the basic principle behind strain gauges?

(03 marks)

c) What are the applications of strain gauges?

(03 marks)

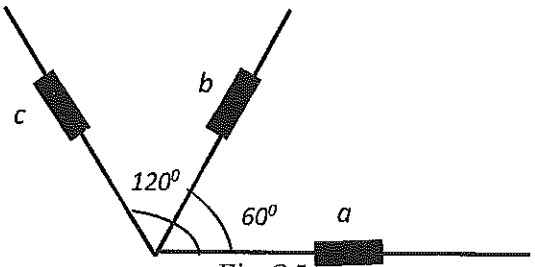

Fig.Q5

The state of strain at a point is measured using the strain rosette shown in Fig.Q5. The readings from the respective strain gauges are,

$$\varepsilon_a = 60x10^{-6}, \varepsilon_b = 135x10^{-6}, \varepsilon_c = 264x10^{-6}$$

Determine the in-plane principal strains and the directions along which they act at the point under consideration.

(11 marks)

Question No.06:

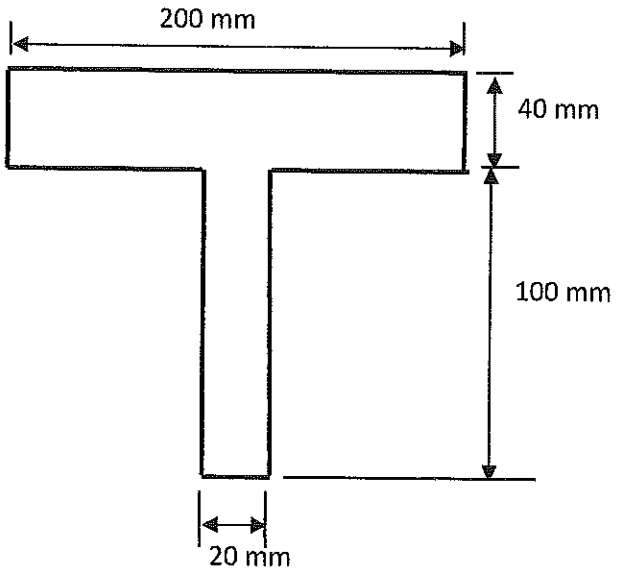

Fig.Q6

The cross section of beam is a T section with overall depth 140 mm, flange width 200 mm, flange thickness 40 mm and web thickness 20 mm as shown in Fig.Q6.

a) Determine the position of the neutral axis.

(02 marks)

b) Find the second moment of area (I) about the neutral axis

(02 marks)

c) If it carries a shear force of 60 kN, obtain the shear stress values at

(i) top and bottom most fibres

(ii) neutral axis

(iii) two adjacent fibres, at the junction of flange and web

(12 Marks)

d) Draw the shear stress distribution diagram.

(04 Marks)

Question No.07:

a) Write the simple torsion formula with usual notations. Explain the meaning of each symbol in the formula with their relevant units.

(04 marks)

b) Determine the torque that can be applied to a solid shaft of 20 mm diameter without exceeding an allowable shearing stress of 80 MPa.

(06 marks)

c) Solve Part (b), assuming that the solid shaft has been replaced by a hollow shaft of the same cross-sectional area and with an inner diameter equal to half of its own outer diameter.

(10 Marks)

END