MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 203: STRENGTH OF MATERIALS I

DATE: **TIME:**

INSTRUCTIONS:

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Differentiate between normal stress and shear stress (2 marks)

b) An aluminum bar 60 mm diameter when subjected to an axial tensile load 100 kN elongates 0.20 mm in a gage length 300 mm and the diameter is decreased by 0.012 mm. Calculate the modulus of elasticity and the Poisson's ratio of the material. (5 marks)

c) Derive the equation to find volumetric strain in thin cylinder subjected to internal pressure. (3 marks)

d) A specimen of steel 20 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80 kN and the load at elastic limit is 102 kN. The maximum load is 130 kN. The total extension at fracture is 56 mm and diameter at neck is 15 mm. Find,

(i) The stress at elastic limit

(ii) Ultimate tensile stress. (6 marks)

e) A bar of cross-section 2.25cm by 2.25cm is subjected to an axial pull of 20kN. Calculate the normal stress and shearing stress on a plane which makes an angle of 60^0 with the axis of the bar (4 marks)

f) State any four assumptions made when developing theory of simple bending (4 marks)

g) A circular steel pipe of external diameter 60 mm and thickness 8 mm is used as a simply supported beam over an effective span of 2 m. If permissible stress in steel is 150 N/mm2, determine the maximum concentrated load that can be carried by it at mid span. (6 marks)

QUESTION TWO (20 MARKS)

a) Draw stress strain diagram for ductile materials and indicate all salient features on it

(10 marks)

b) A specimen of diameter 13 mm and gauge length 50 mm was tested under tension. At 20 kN load, the extension was observed to be 0.0315 mm. Yielding occurred at a load of 35 kN and the ultimate load was 60 kN. The final gauge length at fracture was 70 mm. Calculate yield stress, ultimate strength and percentage elongation. (10 marks)

QUESTION THREE (20 MARKS)

The state of plane stress at a point is represented on the element shown in figure 1. Determine the state of stress at this point on another element oriented 30° clockwise from the position shown.

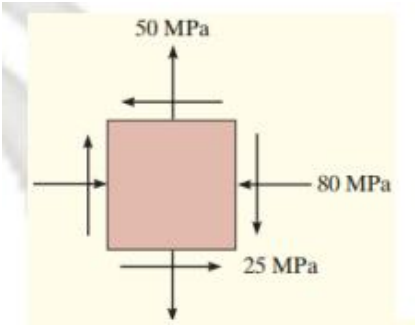

Figure 1

$\sigma_x = 30$ MN/m^2, $\sigma_y = -10$ MN/m^2 and $\tau_{xy} = 20$ MN/m^2.

a) Find the principal stresses and the maximum shearing stress (8 marks)

b) Use Mohr circle to calculate the values of principal stresses and maximum shear stress when the plane is rotated 60^0 to the normal (12 marks)

QUESTION FOUR (20 MARKS)

A symmetric I-section of size 180 mm × 40 mm, 8 mm thick is strengthened with 240 mm × 10 mm rectangular plate on top flange as shown is figure 2. If permissible stress in the material is 150 N/mm2, determine how much concentrated load the beam of this section can carry at centre of 4 m span. Given ends of beam are simply supported.

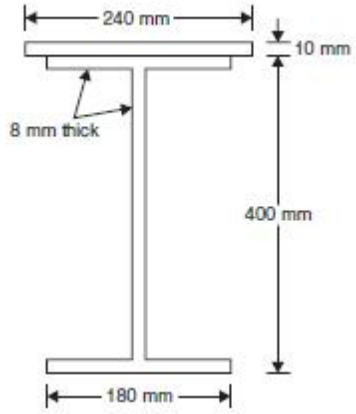

Figure 2

QUESTION FIVE (20 MARKS)

A beam of T -section is having flange 120mm × 15mm and web 100mm × 15mm. It is subjected to a shear force of 24kN. Draw shear stress distribution across the depth marking values at salient points.