



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 203: STRENGTH OF MATERIALS I

DATE:

TIME:

INSTRUCTIONS

- This paper comprises of FIVE questions. Answer **THREE** questions
- Question one is **compulsory** and carry 30 marks
- Answer any other **TWO** questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Define Poisson's ratio and mention its significance in material selection. (3 marks)
- b) Distinguish between elastic section modulus and plastic section modulus stating their significance in structural design. (4 marks)
- c) An aluminum rod has a cross-sectional area of 0.19635 cm^2 . An axial load of 6kN causes the rod to stretch along its length and shrink across its diameter. What is the diameter before and after loading? (4 marks)
- d) The state of two dimensional stress acting on a concrete lamina consists of a direct tensile stress 1.5 N/mm^2 and shear stress 1.20 N/mm^2 which causes cracking of concrete. Calculate the tensile strength of the concrete. (3 marks)
- e) Differentiate between principal planes and principal stresses. (3 marks)
- f) For the given state of stress $\sigma_x = 80 \text{ Mpa}$, $\sigma_y = -20 \text{ Mpa}$ and $\tau_{xy} = 80 \text{ Mpa}$, by how much angle (Θ) the stress element should be rotated in order to get the planes of maximum shear stress (4 marks)

- g) Define simple bending and state two assumptions made in deriving the simple bending formulae. (4 marks)
- h) A symmetric I section shown below (width of each flange 50 mm, thickness of each flange 10 mm, depth of web 10mm) of steel is subjected to a shear force of 100 kN. Find the magnitude of the shear stress in the web at the junction with the top flange. (6 marks)

QUESTION TWO (20 MARKS)

- b) Draw stress-strain curve for a mild steel rod subjected to tension and explain about the salient points on it. (10 marks)
- b) Calculate the strains in the x,y and z direction for this steel block shown in **figure 1** below .
Take $E = 207 \text{ GPa}$ and poissons ratio 0.25 . The block is of 3cm length, 2cm breadth and 4cm height (10 marks)

$$\sigma_x = 3 \text{ kN}, \quad \sigma_y = 5 \text{ kN} \quad \text{and} \quad \sigma_z = -2 \text{ kN}$$

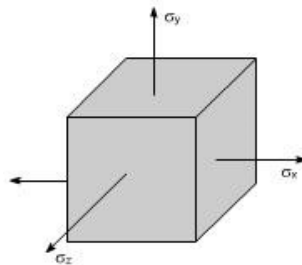
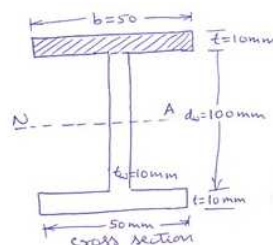


Figure 1

QUESTION THREE (20 MARKS)

A beam has cross-section as shown in **Figure 2**. If the shear force acting on this is 25 kN, draw the shear stress distribution diagram across the depth.



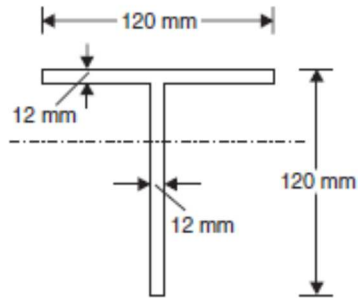


Figure 2

QUESTION FOUR (20 MARKS)

The state of stress at a point is given by the stress component σ_x 70 N/mm², σ_y 10 N/mm² and τ_{xy} -45 N/mm². Using Mohr's circle,

- Find the principal stresses and principal planes.
- Determine the normal and shear stress components on planes making 25°, 40° and 60° respectively with the X plane.

QUESTION FIVE (20 MARKS)

The cross-section of a cast iron beam is as shown in **figure 3** below. The top flange is in compression and bottom flange is in tension. Permissible stress in tension is 30 kN/mm² and its value in compression is 90 N/mm². What is the maximum uniformly distributed load the beam can carry over a simply supported span of 5m.

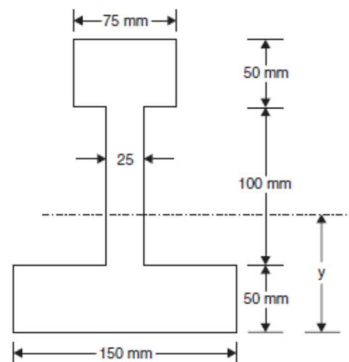


Figure 3