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: 17/12/2021 **TIME: 11:00 – 1:00 PM**

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 1.20N/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 σx 80Mpa σy -20Mpa and τ_{xy} 80 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)

a) 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 GPA and poissons ratio 0.25. The block is of 3cm length, 2cm breadth and 4cm height (10 marks)

σ_x= 3kN, σ_y= 5 kN and σ_z = -2kN

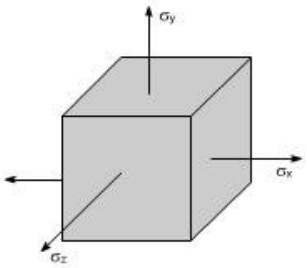
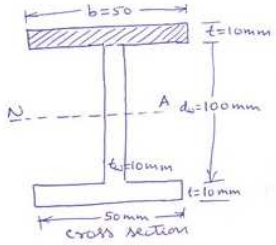


Figure 1

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.



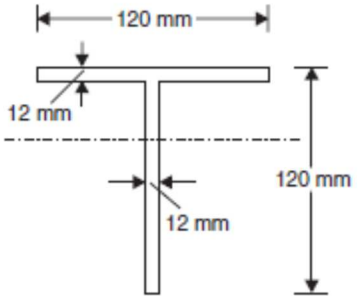


Figure 2

QUESTION FOUR (20 MARKS)

The state of stress at a point is given by the stress component σx 70 N/mm^2 σy 10 N/mm^2 and τ_{xy} -45 N/mm^2. Using Mohrs circle,

a) Find the principal stresses and principal planes.
b) Determine the normal and shear stress components on planes making 25^o, 40^o and 60^o 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/mm^2 and its value in compression is 90 N/mm^2. What is the maximum uniformly distributed load the beam can carry over a simply supported span of 5m.

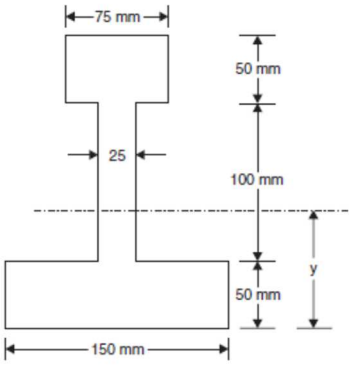


Figure 3