



MACHAKOS UNIVERSITY

UNIVERSITY EXAMINATIONS 2024/2025

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

**SECOND YEAR FIRST SEMESTER EXAMINATION FOR BACHELOR
OF SCIENCE IN CIVIL ENGINEERING**

ECV 215: STRENGTH OF MATERIALS I

Date:

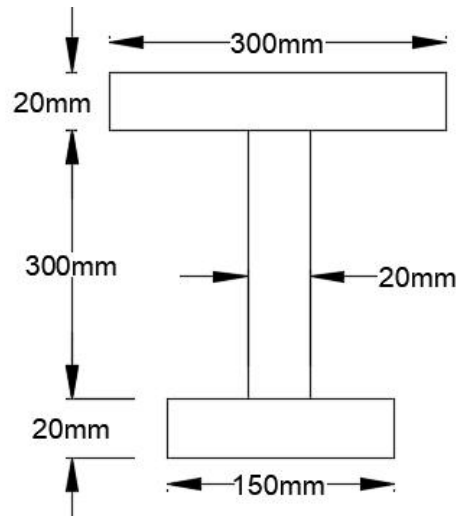
Time :

INSTRUCTIONS

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

QUESTION ONE (30Marks)

- a) List and describe the different types of stresses (**3Marks**)
- b) In an experiment, a bar of 30mm diameter is subjected to a pull of 60kN. The measured extensions on gauge length of 200mm is 0.09mm and the change in diameter is 0.039 mm. calculate the Poisson's ratio and modulus of elasticity (**6Marks**)
- c) Determine the moment of inertia and section modulus of the figure shown below with respect to its centroidal axis. (**6Marks**)



- d) Explain the following section properties showing where they are used
- Section modulus (2Marks).
 - Radius of gyration (2 Marks)
- e) A beam is simply supported and carries a uniformly distributed load of 40kN/m over the whole span. The section of the beam is rectangular having depth as 500 mm. if the maximum stress in the material of the beam is 120 N/mm² and the moment of inertia is $7 \times 10^8 \text{ mm}^4$, find the span of the beam (5 marks)
- f) A rectangular beam 100mm wide and 250 mm deep is subjected to a maximum shear force of 50 kN. Determine the
- average shear stress, (2Marks)
 - maximum shear stress (1 Mark)
 - shear stress at a distance of 25mm above the neutral axis (3 Marks)

QUESTION TWO (20 Marks)

- Draw stress strain diagram for ductile materials and indicate all salient features on it. (5 Marks)
- Explain the various mechanical properties that can be estimated from that diagram in (i) above. (5 Marks)
- Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 30mm and of length 1.5m if the longitudinal strain in a bar during a tensile stress is four times the lateral strain. Find the change in volume, when the bar is subjected to a pressure of 100N/mm². Take $E = 1 \times 10^5 \text{ N/mm}^2$ (10 Marks)

QUESTION THREE (20 Marks)

The state of stress at a point is given by the stress components $\sigma_x = 70$ MPa, $\sigma_y = 10$ MPa, and

$$\tau_{xy} = -40 \text{ MPa.}$$

a) Using Mohr's circle find

(i) Principal stresses, and (6Marks)

(ii) Principal planes. (3Marks)

(iii) Normal and shear stress components on planes making 25° , and 60° respectively with the x plane (3Marks)

b) Verify the results in (i and iii) analytical (8 Marks)

QUESTION FOUR (20 Marks)

a) State any four assumptions made when developing theory of simple bending (4Marks)

b) A T –shaped cross section of a cantilever beam of length 5m carries a UDL of 10 kN/m on full length (span). The width of flange is 100mm and total depth of section is 120mm. Thickness of its flange and web is 15mm each. Determine the maximum bending stress in cantilever (16 Marks)

QUESTION FIVE (20 Marks)

A cast iron bracket subjected to bending has a cross section as shown in the figure below. If the section is subjected to a shear force of 100 kN, draw the shear stress distribution over the depth of the section.

(20Marks)

