



MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

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: 10/8/2021

TIME: 2.00-4.00 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) A beam is made up of three planks, nailed together. Knowing that the spacing between nails is 25mm and that the vertical shear in the beam is $V=500\text{N}$, determine the shear force in each nail (5 marks)

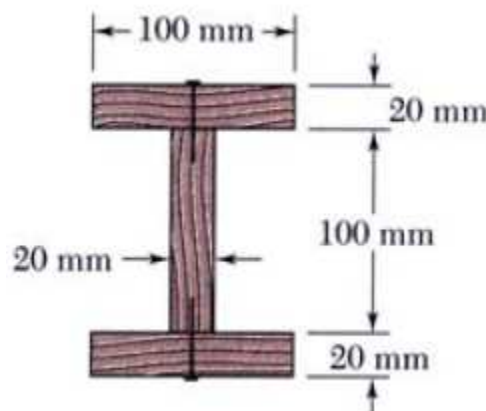


Figure 1

- b) A steel plate of width 120mm and of thickness 20mm is bent into a circular arc of radius 10m. Determine the maximum stress induced and the bending moment which will produce the maximum stress. Take $E=2 \times 10^5 \text{ N/mm}^2$. (5 marks)
- c) Briefly discuss FIVE types of loads in structures (5 marks)
- d) The tensile stresses at a point across two mutually perpendicular planes are 120 N/mm^2 and 60 N/mm^2 . Determine the normal, tangential and resultant stresses on a plane inclined at 30° to the axis of the minor stress. (7 marks)
- e) An axial pull of 3500N is acting on a bar consisting of three lengths as shown in figure 2. If the Young's modulus $= 2.1 \times 10^5 \text{ N/mm}^2$, determine stresses in each section and the total extension of the bar. (8 marks)

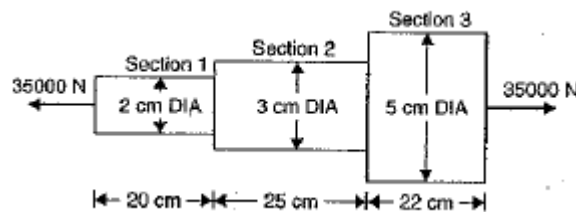


Figure 2

QUESTION TWO (20 MARKS)

At a certain point in a strained material, the intensities of stresses on two planes at right angles to each other are 20 N/mm^2 and 10 N/mm^2 both tensile. They are accompanied by a shear stress of magnitude 10 N/mm^2 . Using Mohr circle, find the location of principal planes and evaluate the principal stresses.

QUESTION THREE (20 MARKS)

- a) A timber beam of rectangular section is simply supported at the ends and carries a point load at the center of the beam. The maximum bending stress is 12 N/mm^2 and maximum shearing stress is 1 N/mm^2 . Find the ratio of the span to the depth. (10 marks)
- b) A simply supported wooden beam of span 1.3m having a cross-section 150mm wide by 250mm deep carries a point load W at the center. The permissible stress are 7 N/mm^2 in bending and 1 N/mm^2 in shearing. Calculate the safe load W . (10 marks)

QUESTION FOUR (20 MARKS)

- a) A metallic bar $250\text{mm} \times 100\text{mm} \times 50\text{mm}$ is loaded as shown in figure 3. Find the change in volume. Take $E = 2 \times 10^5 \text{N/mm}^2$ and poisson's ratio $= 0.25$. Also, find the change that should be made in the 4MN load, in order that there should be no change in the volume of the bar.

(10 marks)

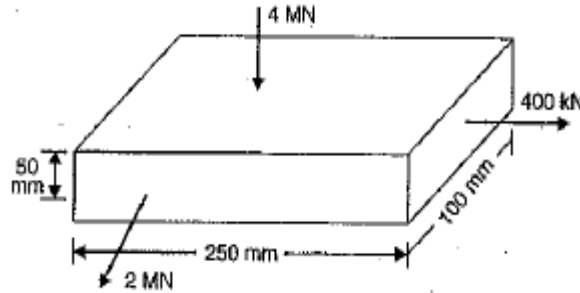


Figure 3

- b) A steel rod 5m long and 30mm in diameter is subjected to an axial tensile load of 50KN. Determine the change in length, diameter and volume of the rod. Take $E = 2 \times 10^5 \text{N/mm}^2$ and poisson's ratio $= 0.25$

(10 marks)

QUESTION FIVE (20 MARKS)

A simply supported beam of length 3m carries a point load of 12KN at a distance of 2m from left support. The cross-section of the beam is shown in figure 4. Determine the maximum tensile and compressive stress at X-X.

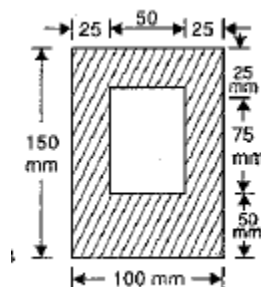


Figure 4.