MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

SECOND YEAR SPECIAL / SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 203: STRENGTH OF MATERIALS I

DATE: 26/8/2022 **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 (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=500N, determine the shear force in each nail (5 marks)

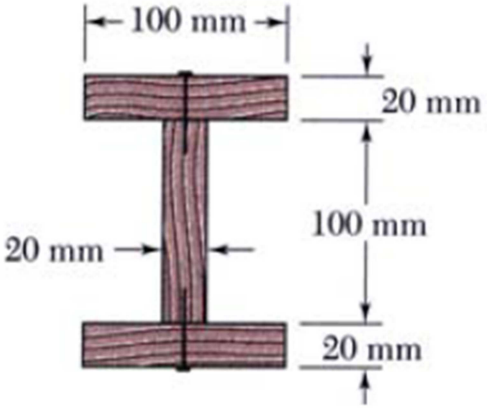

Figure 1

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*10^5N/mm^2 (5 marks)

c) Briefly discuss FIVE types of loads in structures (5 marks)

d) The tensile stresses at a point across tow mutually perpendicular planes are 120N/mm^2 and 60N/mm^2. Determine the normal, tangential and resultant stresses on a plane inclined at 30^o 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 Youngs modulus=2.1*10^5N/mm^2, determine stresses in each section and the total extension of the bar (8 marks)

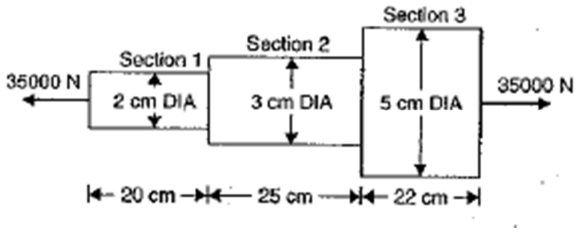

Figure 2

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 20N/mm^2 and 10N/mm^2 both tensile. They are accompanied by a shear stress of magnitude 10N/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 12N/mm^2 and maximum shearing stress is 1N/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 7N/mm^2 in

bending and 1N/mm^2 in shearing. Calculate the safe load W (10 marks)

QUESTION FOUR (20 MARKS)

a) A metallic bar 250mm*100mm*50mm is loaded as shown in figure 3. Find the change in volume. Take E=2*10^5N/mm^2 and poisons 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)

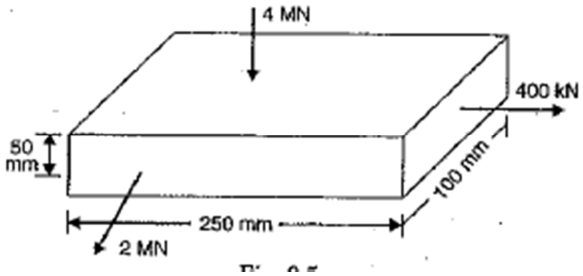

Figure 3

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*10^5N/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

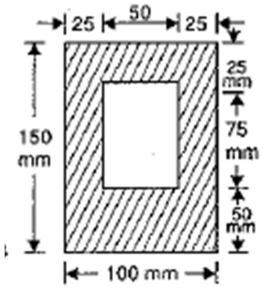

Figure 4.