MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FIRST SEMESTER EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECV 203: STRENGTH OF MATERIALS 1

Date: 8/12/2015 **Time: 8:30 – 10:30 AM**

INSTRUCTIONS:

- ***This paper comprises five questions***
- ***Answer question one and any other two questions***
- ***All the optional questions carry equal marks***

QUESTION ONE (30 MARKS)

a) Define:

(i) Direct Stress in tension and compression. (1 mark)
(ii) Complimentary shear stress. (1 mark)
(iii) Volumetric strain due to hydrostatic pressure. (1 mark)
(iv) Hooke's law (modulus of elasticity). (1 mark)
(v) Poisson's law. (1 mark)
(vi) Shear stress in shear and torsion. (1 mark)

b) A short column has a rectangular cross section with sides in the ratio 1:2 as shown in figure 1. Determine the minimum dimensions of the column section if the column carries an axial load of 800kN and the failure stress of the material of the column is 400N/mm^2. (6 marks)

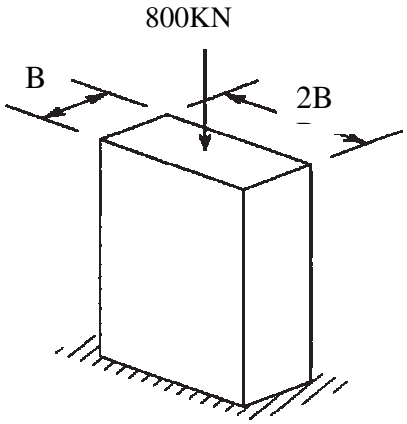

Fig. 1

c) A rod 150cm long and of diameter 2.0cm is subjected to an axial pull of 20kN. If the modulus of elasticity of the material of the rod is 2.0×10^5 determine:

(i) The stress (2 marks)
(ii) The strain (2 marks)
(iii) The elongation of the rod. (2 marks)

d) The safe stress, for a hollow steel column which carries an axial load of 2.1×10^3kN is 125MN/m^2.If the external diameter of the column is 30 cm, determine the internal diameter. (6marks)

e) The ultimate stress, for a hollow steel column which carries an axial load of 1.9MN is 480N/mm^2. If the external diameter of the column is 120 mm, determine the internal diameter. Take factor of safety as 4. (6marks)

QUESTION TWO (20 MARKS)

An axial pull of 3500N is acting on a bar consisting of three lengths as shown in Figure 2. If Young's modulus is 2.1×10^5 N/mm^2 determine:

i) Stresses in each section (10marks)

ii) Total extension of the bar. (10marks)

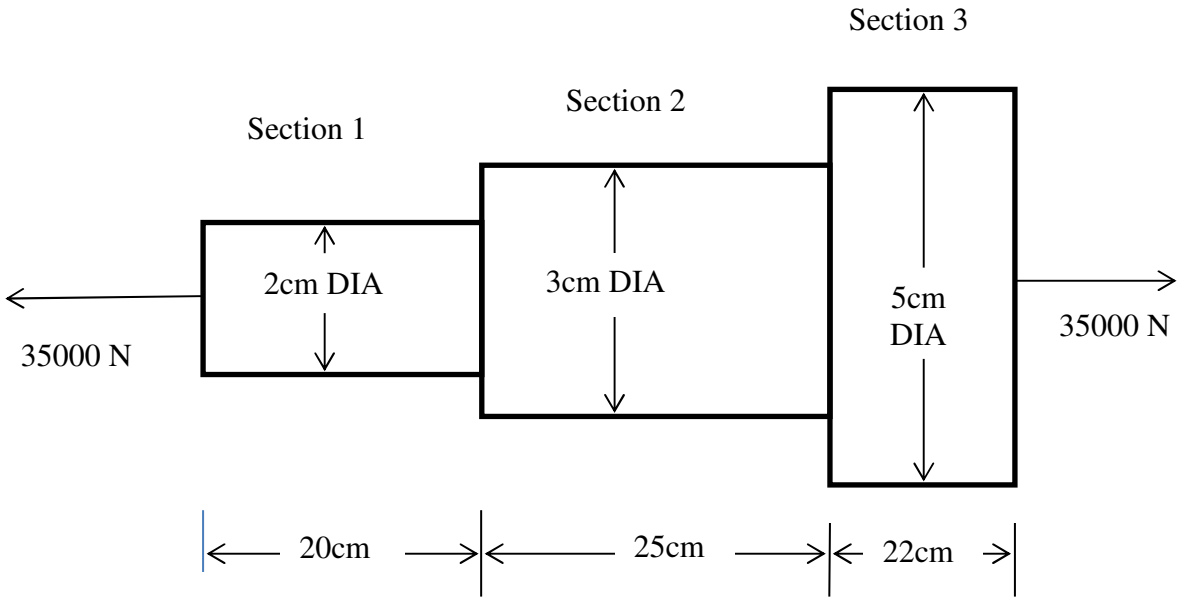

Fig. 2

QUESTION THREE (20 MARKS)

A metallic bar 250 mm x 100 mm x 50 mm is loaded as shown in Figure 3.

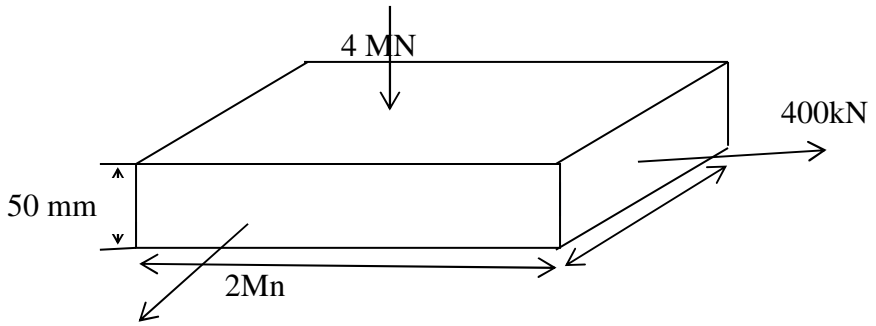

Fig. 3

Find the change:

i) in volume. Take E=2 x 10^5 N/mm^2 and Poisson's ratio=0.25. (10 marks)

ii) that should be made in the 4MN load, in order that there should be no change in the volume of the bar. (10 marks)

QUESTION FOUR (20 MARKS)

A rectangular bar of cross sectional area 10000 mm^2 is subjected to an axial load of 20kN. On its section which is inclined at an angle of 30^0 with normal cross-section, determine the:

i) normal stresses (10 marks)
ii) shear stresses (10 marks)

QUESTION FIVE (20 MARKS)

A cube of material is subjected to a compressive stress σ on each of its faces. If poisson's ratio μ = 0.3 and Young's Modulus $E = 200\,000\ N/mm^2$, calculate the:

i) value of this stress if the volume of the cube is reduced by 0.1%. (10 marks)
ii) percentage reduction in length of one of the sides. (10 marks)