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

SECOND SEMESTER EXAMINATION FOR DIPLOMA IN BUILDING TECHNOLOGY

DIPLOMA IN CIVIL ENGINEERING

BCEBD & BCECD 119: STRENGTH OF MATERIALS I

Date: 02/12/2015 **Time: 8:30 – 10:30 am**

INSTRUCTIONS:

- *This paper comprises of **five** questions*
- *Question **one** is **compulsory** and carry 30 marks*
- *Answer **question one** and any **other two** questions*

1. a) Illustrate four types of loading systems on structural beams (4 marks)

   b) Define the following terms

   (i) Stress
   (ii) Strain
   (iii) Limit of proportionality
   (iv) Elastic limit
   (v) Plastic range

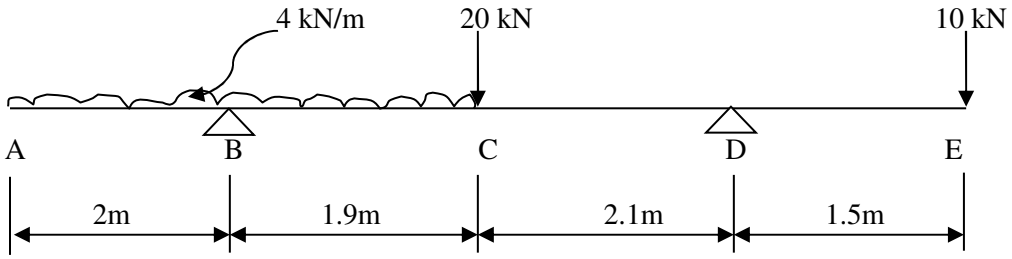
   (10 marks)

   c) A short concrete column of 350mm square section is reinforced with four 20mm diameter bars and carries an axial load of 800 kN. Calculate the stresses in steel and concrete. Take $E_{steel} = 210\ kN/mm^2$ $E_{concrete} = 14\ kN/mm^2$ (10 marks)

d) Show that Show that Young's Modulus $E = \frac{PL}{A.\delta L}$ (6 marks)

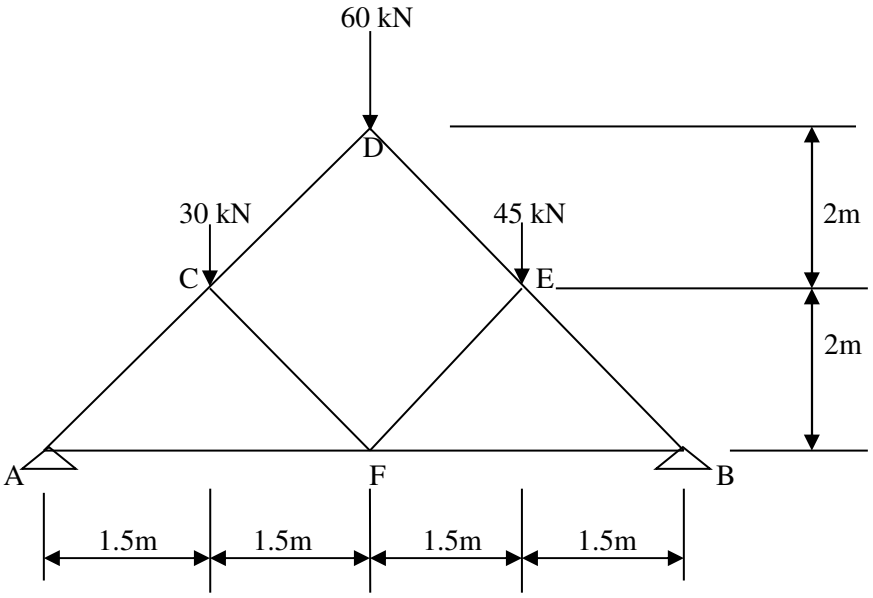
2 a) Define
(i) Shear force
(ii) Bending moment (2 marks)

b) The figure below shows details of a loaded beam ABCDE.



(i) Sketch the shear force and bending moment diagrams for the beam indicating the values at critical points
(ii) Determine the positions of the point of contraflecture (18 marks)

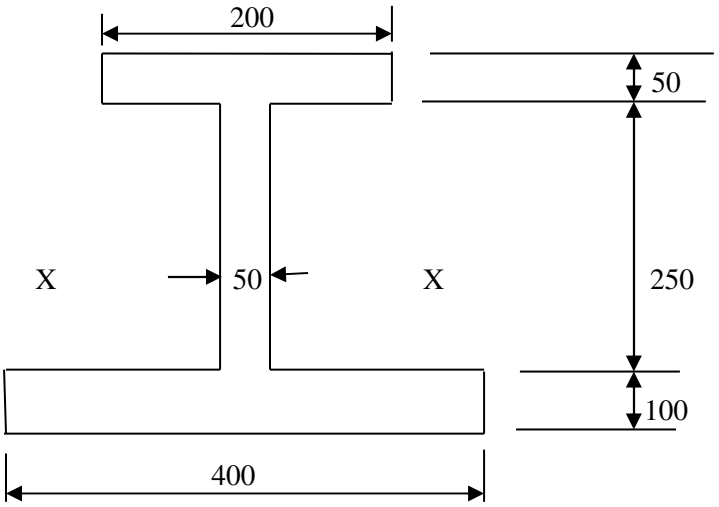
3. Using the method of joint resolution determine the magnitude and nature of forces for each member of the pin-jointed frame shown below.



(20 marks)

4. a) The figure below shows the cross-section of a steel member. Determine the following;

(i) Centre of area
(ii) Second moment of area about both principal axes
(iii) Minimum section modulus
(iv) Least radius of gyration (16 marks)



b) Calculate the safe moment of resistance of the beam section shown in the figure above if the stresses in the upper and lower flanges are limited to 30 N/mm^2 and 20 N/mm^2 respectively. (4 marks)

5. a) Find the Young's modulus of a brass rod of diameter 25mm and of length 250mm which is subjected to a tensile load of 50kN when the extension of the rod is 0.3mm. (6 marks)

b) Two 150 x 75 x 4m long timber members are reinforced with a steel plate 150 x 6 x 4m long as shown below. If the members are rigidly bolted together and the permissible stress for steel is given as 130 N/mm2, E_t and E_s are given as 6200N/mm^2 and 155000N/mm^2 respectively, calculate the permissible tensile load for the composite member and the amount of elongation. (14 marks)