MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2014/2015

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

SECOND SEMESTER EXAMINATION FOR DIPLOMA IN BUILDING CONSTRUCTION TECHNOLOGY AND DIPLOMA IN CIVIL ENGINEERING

BCEBT/BCECD 109: STRENGTH OF MATERIALS I

Date: 07/04/2015 **Time: 08:30 – 10:30 am**

Instructions:

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

1 a) Illustrate four types of beam supports (4 marks)

b) Define the following terms

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

(7½marks)

c) Plot the graph of stress against strain for a mild steel bar tested to destruction indicating all salient points (6½marks)

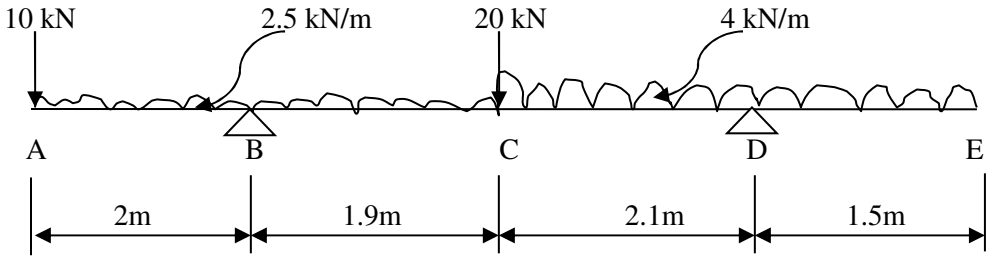
d) A short concrete column of 350mm square section is reinforced with four 20mm diameter bars and carries an axial load of 800 kN. Calculate the stresses in steel and concrete. Take $E_{steel} = 210\ kN/mm^2$ $E_{concrete} = 14\ kN/mm^2$ (6 marks)

e) Calculate the cross-sectional dimensions of a square column that is axially loaded with 360 kN given the permissible stress as 7 N/mm^2 (6 marks)

2 a) Define

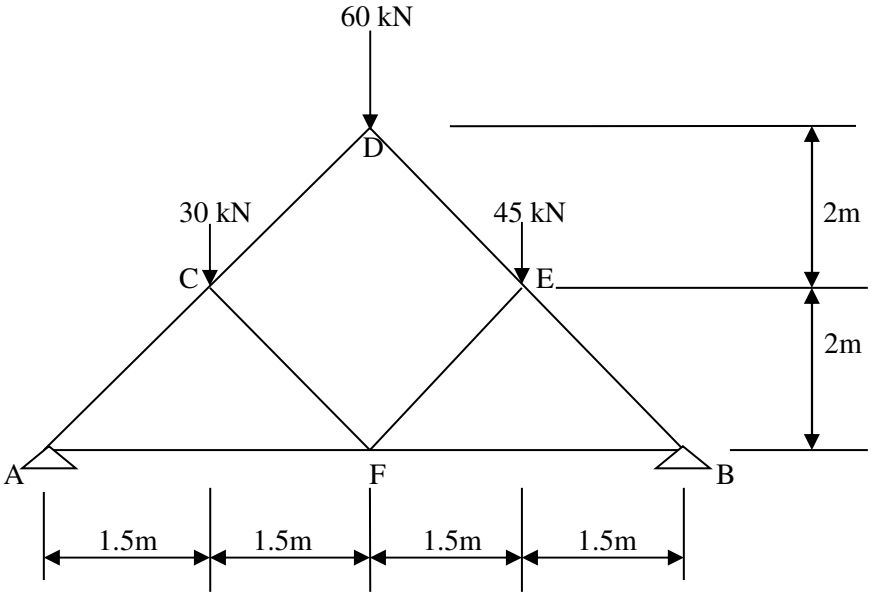
i. Shear force
ii. Bending moment (2 marks)

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)

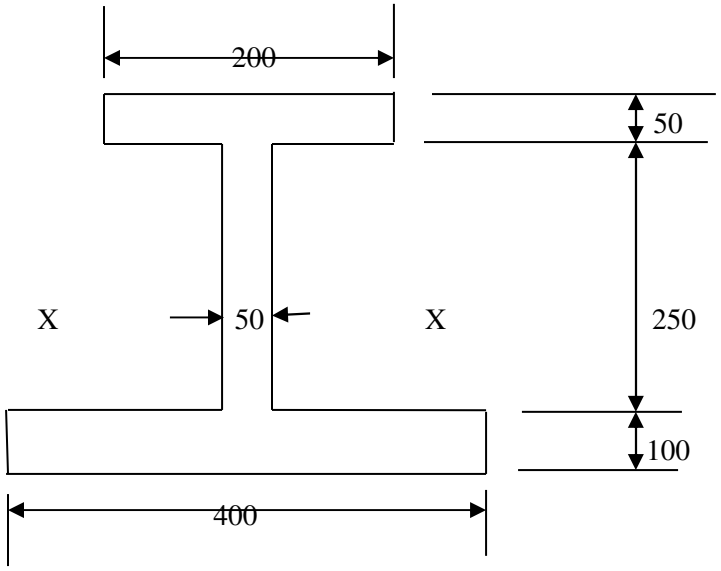
3 Using the method of joint resolution determine the magnitude and nature of forces for each member of the pin-jointed frame shown below.



(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 (14 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. (6 marks)

5 a) Show that Show that Young's Modulus $E = \frac{PL}{A.\delta L}$ (8 marks)

b) A flitched beam is simply supported over a span of 5 m and carries a uniformly distributed load of 2 kN/m over the entire span. If the beam cross-section is as shown below, determine the maximum tensile and compressive stresses developed in both the materials due to the loading. (Take E_s = 210 kN/mm^2 and E_t = 10 kN/mm^2). (12 marks)