



TECHNICAL UNIVERSITY OF MOMBASA  
**Faculty of Engineering &  
Technology**

DEPARTMENT OF BUILDING & CIVIL ENGINEERING  
**UNIVERSITY EXAMINATION FOR:  
BACHELOR OF SCIENCE IN CIVIL ENGINEERING  
(BSCE)**

ECE 2204: STRENGTH OF MATERIALS

**END OF SEMESTER EXAMINATION  
SERIES: APRIL 2014  
TIME ALLOWED: 2 HOURS**

**Instructions to Candidates:**

You should have the following for this examination

- Answer booklet
- Scientific Calculator

This paper consists of **FIVE** questions.

Answer question **ONE (COMPULSORY)** and any other **TWO** questions

All questions carry equal marks

Maximum marks for each part of a question are as shown

This paper consists of **THREE** printed pages

---

**Question One (COMPULSORY)**

a) Proof from simple bending theory that:

$$\frac{M}{I} = \frac{E}{R} = \frac{\delta}{y}$$

**(8 marks)**

b) A copper rod of 40mm diameter is surrounded tightly by a cast-iron tube of 80mm external diameter the ends being firmly fastened together. When put to a compressive load of 30KN:

- (i) What load will be shared by each i.e. cast iron; copper rod
- (ii) Determine the amount by which the compound bar shortens if it is 2m long.

Take:

$$E_{c.i \text{ (cast iron)}} = 175 \text{ GN/m}^2$$

$$E_{\text{copper}} = 75 \text{ GN/m}^2$$

(11 marks)

c) Explain the sign convention for S.F and B.M diagrams.

(5 marks)

d) Show the relation between:

(i) Young's modulus (E) and Bulk modulus (K)

(ii) Young modulus (E) and shear modulus (C)

(6 marks)

### Question Two

a) Derive the expressions for the following stresses on a inclined section through a body subjected to direct stress in two mutually perpendicular directions:

(i) Normal stress

(ii) Shear stress

(14 marks)

b) A point in a strained material subjected to mutually perpendicular tensile stress of  $60 \text{ N/mm}^2$  and  $40 \text{ N/mm}^2$ . Determine the following stresses on a section through the body inclined at  $30^\circ$  with the vertical.

(6 marks)

(i) Normal stress

(ii) Shear stress

(iii) Resultant stress

### Question Three

Describe a lab test to determine the tensile strength of a piece of mild steel reinforcement bar. Sketch out the apparatus used.

(20 marks)

### Question Four

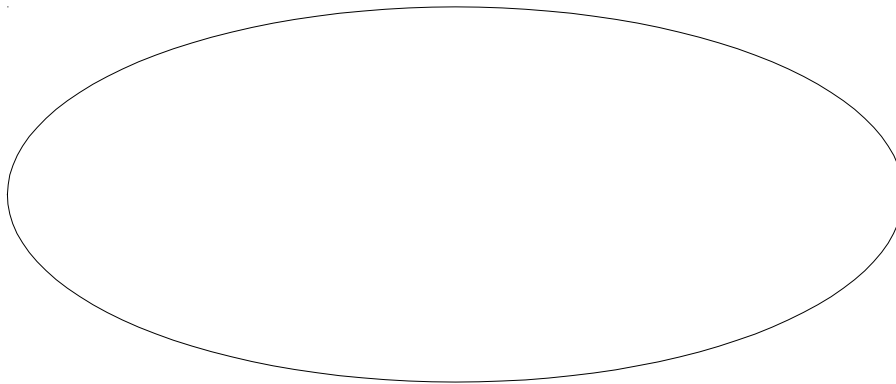
For the shaded area shown in figure 4 find the following:

a) The position of the centroid

b) The second moment of area about the base

c) The radius of gyration about the base.

(20 marks)



### Question Five

Draw the shear force and bending diagrams for the beam shown I figure 5. Clearly mark the position of the maximum bending moment and determine its value.

B