THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

University Examination 2010

SECOND YEAR/FIRST SEMESTER EXAMINATION
FOR THE DEGREE IN BACHELOR OF SCIENCE IN CIVIL ENGINEERING
SUPPLEMENTARY PAPER

ECE 2204: STRENGTH OF MATERIALS I

SERIES: APRIL/MAY 2010 **TIME:** 2 HOURS

Instructions:

You should have the following for this examination:
- Answer booklet
- Mathematical table/pocket calculator

Question **ONE** is Compulsory. Answer any other **TWO** questions from the remaining FOUR questions.

QUESTION ONE

(a) State ten assumptions in simple bending theory. (10 marks)

(b) Define the following terms:

(i) Modulus of elasticity

(ii) Proof stress (6 marks)

(c) For a two dimensional complex stress system, show that

$$\sigma_\theta = \frac{\sigma x + \sigma y}{2} + \frac{\sigma_x - \sigma_y}{2} Cos2\theta + \tau_{xy} Sin2\theta$$ (14 marks)

QUESTION TWO

(a) A steel wire 2m long and 3mm in diameter is extended by 2.75mm when a weight w is suspended from the wire. If the same weight is suspended from a brass wire 2.5m long and 2mm in diameter, it is elongated by 4.64mm. Determine the modulus of elasticity of brass if that of steel be 2.0x105N/mm^2. (8 marks)

(b) At a point in a bracket the stresses on the mutually perpendicular planes are 35MN/m^2 (tensile) and 15MN/m^2 (tensile). The shear stress across these planes is 9MN/m^2. Find the magnitude and direction of the resultant stress on a plane making an angle of 40° with the plane of first stress. Find also the normal and tangential stresses on the planes. (12 marks)

QUESTION THREE

(a) Find that $\frac{\sigma}{y} = \frac{E}{R}$ using the simple bending theorem. (6 marks)

(b) A 250mm (depth) x 150mm width rectangular beam is subjected to maximum bending moment of 750knM. Determine:

(i) The maximum stress in the beam.
(ii) If the value of E for the beam material is 200GN/m2, find out the radius of curvature for that portion of the beam where the bending is maximum.
(iii) The value of the longitudinal stress at a distance of 65mm from the top surface of the beam. (12 mark)

QUESTION FOUR

(a) Derive the expression for the moment of inertia of a triangular section by the integration method. (6 marks)

(b) Find the centroidal moment of inertia of the shaded area shown in the figure. (14 marks)

QUESTION FIVE

(a) From figure 5, draw the shear force diagram (SFD) and bending moment diagrams (BMD) for the beam. (4 marks)

(b) A uniform T section beam is 100mm wide and 150mm deep with a flange thickness of 120mm. If the limiting bending stress for the material of the beam are 80MN/m^2 in compression and 160MN/m^2. Find the maximum uniformly distributed load that the beam can carry over a simply supported span of 5m. (16 marks)