THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

University Examination 2010

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

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) Sketch a typical stress-strain curve for mild steel and define the **FOUR** most important points on it. (8 marks)

(b) Define the following terms:

(i) Stress

(ii) Total stress and unit stress

(iii) Compressive strain (6 marks)

(c) A steel bar is 900m long; its two ends are 40mm and 30mm in diameter and the length of each rod is 200mm. The middle portion of the bar is 15mm in diameter and 500mm long. If the bar is subjected to an axial tensile load of 15KN, find its total extension. (8 marks)

(d) An element in plane stress is subjected to stresses $\sigma_x = 16{,}000 N/mm^2$, $\sigma_y = 6{,}000 N/mm^2$ and $\tau_{xy} = 4{,}000 N/mm^2$. Determine the stresses on an element inclined at an angle of $\theta = 45°C$ (8 marks)

QUESTION TWO

(a) Proof that for body subjected to a direct tensile stress in one plane, the magnitude of maximum shear stress on an inclined section is half of the tensile stress. (6 marks)

(b) Draw the Mohr's stress circle for direct stresses of 65MN/m^2 (tensile) and 35MN/m^2 (compressive) and estimate the magnitude and direction of the resultant stresses and planes making angles of 20° and 65° with the plane of the first principle stress. Find also the normal and tangential stresses on truss planes. Confirm your results analytically. (14 marks)

QUESTION THREE

(a) Using the theory of simple bending, prove the relationship

$$\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$$ (8 marks)

(b) Determine the dimensions of joist of timber for span 8m to carry a brick wall 200mm thick and 5m high, if the density of the brick work is 1850Kg/m^3 and the maximum permissible stress is limited to 75MN/m^2. Given that depth of joist is twice the width. (12 mark)

QUESTION FOUR

(a) Derive the expression for the moment of inertia of a rectangular section by the integration method.

(b) A T-Beam is made up of two plates and two angles as shown in figure 4. Determine the moment of inertia of T-Section above an axis passing through the centroid of the section and parallel to the top plate. (20 marks)

QUESTION FIVE

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

(b) Determine the equation for bending moment and shear force for a straight beam with uniformly distributed Load. (20 marks)