THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMINATIONS FOR BACHELOR OF SCIENCE IN CIVIL ENGINEERING
YR II, SEM I

ECE 2204 : STRENGTH OF MATERIALS I

END OF SEMESTER EXAMINATION

SERIES: AUGUST/SEPTEMBER 2011

TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination

- *Answer booklet*
- *Battery Powered Programmable calculators may be used*

This paper consists of **FIVE** questions in **TWO** sections **A & B**
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **FOUR** printed pages

SECTION A (*COMPULSORY – 30 MARKS***)**

Question 1

$\sigma_y = 270Mpa$)

a) A short piece of steel pipe (is to carry an axial compressive load P = 1200KN with a factor of safety of 1.8 against yielding. If the thickness t of the pipe is to be one eighth of its outside diameter, find the minimum required outside diameter d (6 marks)

b) A steel bar of length 2.5m with a square cross section 100mm on each side is subjected to an axial tensile force of 1300KN. Assuming that E = 200 Gpa and v = 0.3, find;

(i) The elongation of the bar,
(ii) The change in cross-sectional dimensions, and
(iii) The change in volume (9 marks)

c) An element in plane stress is rotated through angle of 60^{o}. on the rotated element, the normal and shear stresses have the magnitudes and directions shown in the figure. Determine the normal and shear stresses on an element whose sides are parallel to the xy axes; that is determine σ_x, σ_y *and* τ_{xy}

(15 marks)

SECTION B (*Answer any TWO questions from this section. Each question carries 20 marks***)**

Question 2

An aluminium alloy specimen of 1.2mm thickness and 25mm width cross section and a parallel gauge length of 50mm is tested in tension giving the following data.

Load (KN)	1.8	3.6	5.4	6.4	7.2	7.6	8.0	8.4	8.8	9.2	10.8
Extension (mm)	0.0443	0.886	0.133	0.155	0.181	0.198	0.219	0.246	0.281	0.332	0.645

Load (KN)	12.0	12.4
Extension (mm)	1.05	1.94

Determine values for:

(i) Young's modulus
(ii) 0.1% proof stress
(iii) 0.5% proof stress
(iv) The ultimate tensile stress (20 marks)

Question 3

A brass sleeve is fitted over a steel bolt (see figure) and the nut is tightened until it is just snug. The bolt has a diameter of 25mm, and the sleeve has inside and outside diameters of 26mm and 3mm respectively. Calculate the temperature rise ΔT that is required to produce a stress in the sleeve of 30Mpa compression. (Use material properties as follows: for brass $\alpha_b = 20x10^{-6}/^o C$ and $E_b = 100Gpa$; for steel $\alpha_b = 12x10^{-6}/^o C$ and $E_s = 200Gpa$ (20 marks)

Question 4

A simple beam AB with span L = 14 m supports a uniform load q that includes the weight of the beam (see figure). The beam is constructed of three plates welded together to form the cross section shown. Determine the maximum permissible load q based upon bending and shear if the allowable stresses are $\sigma_{allow} = 110 Mpa$ and $\sigma_{allow} = 70 Mpa$ (20 marks)

Question 5

a) By means of a suitable sketch, show how the proof stress is determined (5 marks)

b) An element in pure shear is subjected to stresses τ_{xy} as shown in the figure. Using Mohr's circle determine:

(i) The stresses acting on an element rotated through an angle $\theta = 75^o$ from the x axis and

(ii) The principal stresses. Show the results on properly oriented elements (15 marks)