THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)
Faculty of Engineering and Technology

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECE 2204: STRENGTH OF MATERIALS I

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: FEBRUARY/MARCH 2012
TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer booklet*
- *Battery Powered Programmable Calculators*

This paper consists of **FIVE** questions
Answer question **ONE (COMPULSORY)** from **SECTION A** and any other **TWO** questions from **SECTION B**
Maximum marks for each part of a question are clearly shown
This paper consists of **THREE** printed pages

SECTION A (COMPULSORY)

Question 1 (20 marks)

a) Write short notes on the following giving any formulae where necessary:-
   (i) Hooke's law (5 marks)
   (ii) Poisson's Ratio (5 marks)
   (iii) Volumetric Strain (3 marks)

b) Draw a neat sketch of the stress-strain curve for steel in tension showing all the important points (12 marks)

c) A sample of aluminum is tested in tension. The load is increased until a strain of 0.0075 is reached; the corresponding stress in the material is 443 MPa. The load is then removed and the permanent strain of 0.0013 is found to be present. What is the modulus of elasticity E of the aluminum (2 marks)

d) Sketch the stress-strain curve in (a) above (3 marks)

SECTION B (Answer any TWO questions from this section)

Question 2 (20 marks)

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

a) List the FOUR assumptions made in the derivation of the expression (4 marks)

b) The T-beam shown has cross-sectional dimensions given. Determine the maximum shear stress τ_{max} in the web if V = 68 KN.

Question 3 (20 marks)

a) A high-strength steel rod (E=200Gpa,v = 0.30) is compressed by an axial force P. When there no axial load, the diameter of the rod is 50mm. In order to maintain certain clearances, the diameter of the rod must not exceed 50.02mm. What is the largest permissible load P? (4 marks)

b) Calculate the moment of resistance of the beam section shown in the figure below if the stresses in the upper and lower flanges are limited to 20N/mm2 and 30N/mm2, respectively. (16 marks)

Question 4 (20 marks)

A tensile test has been carried out on a mild steel specimen 10mm thick and 50mm wide rectangular cross section. An extensometer was attached over a 100mm gauge length and load extension readings were obtained as follows:

Load (KN)	16	32	64	69	128	136	144	152	158
Extension (mm)	0.016	0.032	0.064	0.096	0.128	0.137	0.147	0.173	0.605

Load (KN)	154	168	208	222	226	216	192	185.4
Extension (mm)	1.181	2.42	7.25	12.0	16.8	22.0	24.0	Fracture

Plot the stress strain curves and determine values for:

(i) Young's modulus
(ii) Proportional limit stress
(iii) Yield point stress
(iv) The ultimate tensile stress
(v) Percent elongation
(vi) 0.2% proof stress (20 marks)

Question 5 (20 marks)

a) An element in plane stress is subjected to stresses $\sigma_x = 50Mpa$ and $\sigma_y = 30Mpa$ acting together with a shear stress τ_{xy}. If the major principal stress $\sigma_1 = 120Mpa$ determine:

(i) The maximum shearing stresses (2 marks)
(ii) The shearing stress τ_{xy} (3 marks)
(iii) The normal and shearing stresses acting on the faces of an element rotated through an angle of 50°. Sketch the stresses on a properly oriented element (8 marks)

b) Represent all the information in (a) above on a Mohr Circle (7 marks)