THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMIANTION FOR BACHELOR OF SCIENCE IN BUILDING & CIVIL ENGINEERING

EBC 4201: STRENGTH OF MATERIALS I

SPECIAL/SUPPLEMENTARY EXAMINATON
SERIES: OCTOBER 2011
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)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

SECTION A (COMPULSORY)

Question 1

a) Explain the meaning of the following terms:

i.	Stress	(1 mark)
ii.	Strain	(1 mark)
iii.	Brittle Material	(1 mark)
iv.	Ductile Material	(1 mark)
v.	Elasticity	(2 marks)
vi.	Plasticity	(2 marks)
vii.	Creep	(2 marks)

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

c) Determine the maximum allowable span length L for a simply supported beam of rectangular cross-section (b=150mm and h= 300mm) subjected to a uniformly distributed load of q = 6.5KN/m if the allowable bending stress is 8.2 Mpa. (The weight of the beam is included in the load q) (8 marks)

SECTION B (Answer *any TWO questions from this section*)

Question 2

$$\frac{M}{1} = \frac{E}{R} = \frac{\sigma}{y}$$

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

b) Calculate the moment of resistance of the beam section shown in the figure 1 below if the stresses in the upper and lower flanges are limited to 25N/mm^2 and 40N/mm^2, respectively. (16 marks)

Fig 1

Question 3

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 100 mm gauge length and load extension readings were obtained as follows:

Load (KN)	16	32	64	96	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 ofr (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 4

a) A thin strip of copper (E = 120 GPa) having length L = 1.5m and thickness t = 1mm is bent into a circle and held with the ends just touching. Calculate the maximum bending stress σ_{max} in the strip (4 marks)

b) A wide flanged beam (see figure 2) having cross-sectional dimensions b = 160mm, t = 10 mm, h = 500 mm and h_1 = 480 mm is subjected to a shear force V = 200KN.

Fig 2

i. Calculate the maximum and minimum shear stresses τ_{max} and τ_{min} in the web.

ii. Compare the maximum with the average shear stress τ_{aver} obtained by dividing V by the area of the web.

iii. Calculate the total shear force V_{web} carried in the web. (16 marks)

Question 5

a) An element in plane stress is subjected to stresses $\sigma_x = 50Mpa$ and $\sigma_y = -30Mpa$ acting together with shearing stresses $\tau_{xy} = 40Mpa$. Determine by calculation:

i. The maximum shearing stresses (2 marks)

ii. The principal stresses (4 marks)

iii. The normal and shearing stresses acting on the faces of an element rotated through an angle of 30^o. (6 marks)

b) Represent all the information in (a) above on a Mohr Circle (8 marks)