



# THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

*Faculty of Engineering and Technology*

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

## UNIVERSITY EXAMINATION FOR BACHELOR OF SCIENCE IN BUILDING & CIVIL ENGINEERING

EBC 4221: STRENGTH OF MATERIALS II

**SPECIAL/SUPPLEMENTARY EXAMINATION**

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 **FOUR** printed pages

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### **SECTION A (COMPULSORY)**

#### **Question 1**

- a) A hollow circular shaft is being designed to transmit 120KW at 1.75Hz. The inside diameter of the shaft is to be one-half of the outside diameter. Assuming that the allowable shear stress is 45 Mpa, calculate the minimum required outside diameter  $d$ . (14 marks)
- b) A strut has the following cross section:

Harsh

In the length of the strut is 3.0 calculate the Euler buckling load if;

- i) Both ends of the strut are pinned
- ii) Both ends of the struts are fixed
- iii) One end is fixed and the other pinned

Take  $E = 210\text{GN/m}^2$ .

(16 marks)

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

#### Question 2

- a) A hollow circular tube of metal is subjected to twisting by torques  $T$  applied the ends. The bar has a length  $L=0.5\text{m}$  and the inside and outside diameters are 30mm and 40mm, respectively. It is determined by measurement that the angle of rotation  $\phi$  is 0.068 radians when the torque  $T$  is 650Nm. Calculate the shear modulus of elasticity  $G$  for the material.

(8

marks)

- b) A wood beam of dimensions  $b = 200\text{mm}$  and  $h = 300\text{mm}$  is reinforced on its sides by steel plates 12 mm thick. The moduli of elasticity for the steel and wood are  $E_s = 204\text{Gpa}$  and  $E_w = 8.5\text{Gpa}$ , respectively. Also the corresponding allowable stresses are  $\sigma_s = 130\text{Mpa}$  and  $\sigma_w = 8.5\text{Mpa}$ . Calculate the maximum allowable bending moment  $M_{\max}$  about the x-axis.

(12 marks)

#### Question 3

A simply supported composite beam is loaded with a single concentrated load  $P$  at midspan. The beam has a span of 4m and is made of wood section ( $b=150\text{mm}$  and  $h = 250\text{mm}$ ) reinforced with a steel plate 150mm wide by 10mm thick at its lower side. Determine the minimum load  $P$  if the allowable stresses in wood and steel are  $\sigma_w$  Mpa and 100 Mpa respectively. Take Young's modulus to be 210 Gpa for steel and 10 Gpa for wood.

(20 marks)

#### **Question 4**

A beam has the following cross-section:

If it is subjected to an axial load of 180KN and a sagging moment of 24 KNm, determine the maximum compressive and tensile stresses acting on the beam if the axial load were both compressive and tensile. (20 marks)

#### **Question 5**

Determine the earth pressure distribution for the retaining wall shown:

Use the following data:

$\gamma_m$   
for wall material = 24KN/m<sup>3</sup>

$\gamma_s$   
for wall soil = 18KN/m<sup>3</sup>

Angle of internal friction  $\phi = 35^\circ$   
Retained soil slopes at  $25^\circ$  to the horizontal  
Assume same soil retained on both sides of the wall.