



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

Institutional-Based Programme

DIPLOMA IN MECHANICAL ENGINEERING (PRODUCTION OPTION)
DIPLOMA IN MECHANICAL ENGINEERING (PLANT OPTION)
DIPLOMA IN MECHANICAL ENGINEERING (AUTOMOTIVE OPTION)

EME 2204: STRENGTH OF MATERIALS II STAGE II

END OF SEMESTER EXAMINATIONS

SERIES: AUGUST/SEPTEMBER 2011

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Scientific calculator*
- *Drawing instruments*

This paper consists of **FIVE** questions

Questions **ONE** is **COMPULSORY**. Answer any other **TWO** questions

Maximum marks per each question are shown

This paper consists of **THREE** printed pages

Question 1 (Compulsory)

- a) Given that a solid circular shaft has a length L and radius r in cross section, prove stating the assumptions made that when a torque T is applied along the longitude axis:

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$$

Where; T = torque, J = polar 2nd moment of area, r = radius of shaft, θ = angle of twist, G = Young's modulus of rigidity, and L = length of shaft.

- b) With reference to Castigliano's theorem, Prove an expression that relates the deflection under a specific point load W on a beam and the strain energy U stored in that beam.

(20 marks)

Question 2

A wooden plank is 240mm wide and 80mm deep. It is supported at each end of a span of 4m. It carries concentrated loads each 1kN at a distance of 1.2m from each end. Assuming fundamental formulae only, calculate the deflection of the beam under the loads and at the centre of the span. Neglect the weight of the beam.

$$\text{Take : } E = 14 \text{GN} / \text{m}^2$$

(20 marks)

Question 3

- a) A leaf spring is required to satisfy the following specifications $L=0.75\text{m}$, $W=k\text{N}$, $b=75\text{mm}$; maximum stress, $210\text{N}/\text{m}^2$, maximum deflection 25mm ; $E=200\text{GN}/\text{m}^2$. Find number of leaves and their thickness.

- b) If the leaves become straight when this load is applied, find the initial radius of curvature.

(20

marks)

Question 4

A hollow shaft having the external diameter twice the internal diameter subjected to pure torque attain a maximum shear stress τ show that the strain energy stored per unit volume of the shaft is

$$5\tau^2 / 16G.$$

Such a shaft is required to transmit 4500kW at $110\text{ rev}/\text{min}$ with uniform torque, the maximum stress not exceeding $70\text{MN}/\text{m}^2$. Calculate;

- i) The shaft diameter
- ii) The energy stored per m^2 when transmitting this power

$$TAKE : G = 83GN / m^2$$

(20 marks)

Question 5

Obtain an expression for the vertical displacement of point A in the bent cantilever show in figure 1 which is of breadth b

If $a=50mm$, $t=6mm$, $b=25mm$ and the beam is of steel. Find the vertical displacement of A for $W = 20N$

$$E = 200GN / m^2$$

(20 marks)