



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A CONSTITUENT COLLEGE OF JKUAT)

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING
DIPLOMA IN MECHANICAL (PRODUCTION OPTION)
DIPLOMA IN MECHANICAL (PLANT OPTION)
DIPLOMA IN MECHANICAL (AUTOMOTIVE OPTION)

EME 2309 **STRENGTH OF MATERIALS III**

STAGE III SEMESTER I
SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: MARCH, 2012

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. You should have the following for this examination
 - Answer booklet
 - Scientific calculator
 - Drawing instruments
2. This paper consists of **FIVE** questions
3. Answer any **THREE** questions.
4. Maximum marks per each question are shown.
5. This paper consists of **THREE Printed pages**.

QUESTION ONE

a) With reference to *Castigliano's* theorem prove the following relationship:

$$\delta = \frac{\partial U}{\partial W}$$

Note: the variables maintain their usual meaning

(10 marks)

b) Given that a solid circular shaft has a length L and radius r in cross section, prove stating the assumptions made the simple torsion equation, when a torque T is applied along the longitudinal axis;

(10 marks)

QUESTION TWO

With reference to strain energy method deduce an expression for the maximum deflection of a cantilever beam of length L carrying a uniformly distributed load ω N/M over its entire length with a point load W at the free end.

(20 marks)

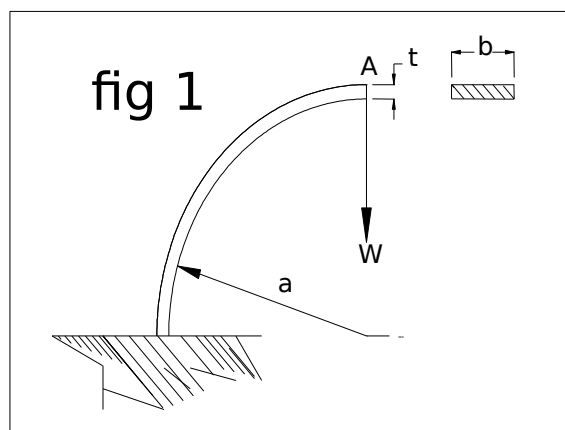
QUESTION THREE

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

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

$$E = 200\text{GN/m}^2$$

(20 marks)



QUESTION FOUR

A solid circular shaft of **25mm** diameter is to be replaced by a hollow shaft, the ratio of external to internal diameter is **2 to 1**. From the given information determine;

- i) The diameter of the hollow shaft if the maximum shearing stress is to be the same as for the solid shaft.
- ii) What Percentage economy in mass will this change effect.

(20 marks)

QUESTION FIVE

A solid steel shaft of 50mm diameter is to be coupled in series with hollow alloy shaft of the same external diameter. Find the internal diameters of the alloy shaft if the angle of twist per unit length is to be 75% of the steel. The limit of shearing stress are to be 55 and 80 MN/m² in the alloy and steel respectively.

Determine the speed at which the shafts are to be driven to transmit 2000 KW.

$$G_{steel} = 22 \times G_{alloys}$$

(20 marks)