



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A CONSTITUENT COLLEGE OF JKUAT)

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING (PRODUCTION OPTION)

DIPLOMA IN MECHANICAL ENGINEERING (PLANT OPTION)

DIPLOMA IN MECHANICAL ENGINEERING (AUTOMOTIVE OPTION)

EME 2310 STRENGTH OF MATERIALS IV

STAGE III SEMESTER II

SPECIAL/SUPPLEMENTARY EXAMINATIONS

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 1

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

$$U = \int \frac{M^2}{2EI} dx$$

Note: the variables maintain their usual meaning.

(10 marks)

b) For a closed coil spring show that the resilience can be given by:

$$u = \frac{\tau^2}{4G}$$

Where: $u = \text{resilience}$

$\tau = \text{Shear stress}$

Note: any other formulae used must be proved

(10 marks)

QUESTION 2

An axially loaded close-coiled spring whose free length is to be 50mm is required to have strain energy of **0.45J** when the maximum shearing stress is 50NM/m^2 and the spring is fully compressed (i.e. coils touching). Assuming a mean coil diameter of 25mm, determine;

- i. The diameter of the steel wire
- ii. The number of coils required

Take: $G = 80\text{GN/m}^2$

(20 marks)

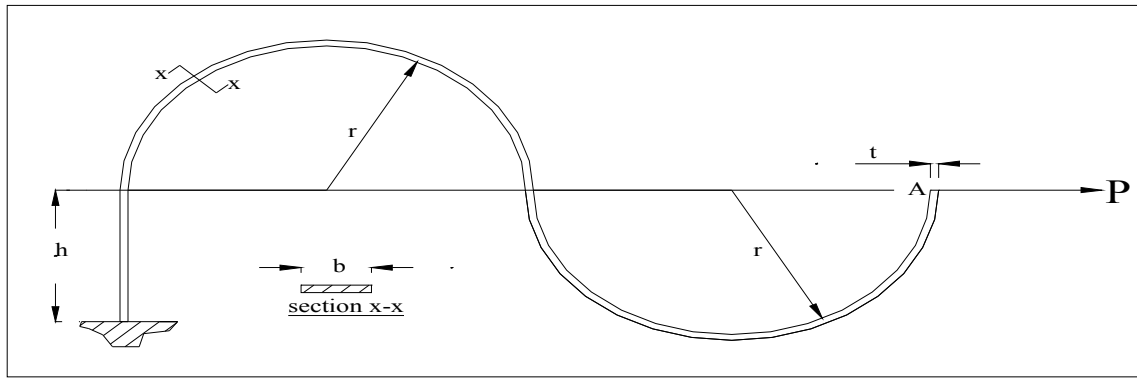
QUESTION 3

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

If $r = 40\text{mm}$, $t = 6\text{mm}$, $b = 20\text{mm}$, $h = 80\text{mm}$ and the beam is of steel. Find the horizontal displacement of A for $W = 25\text{N}$

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

(20 marks)



QUESTION 4

- Deduce an expression for the central deflection of a carriage spring when simply supported at the ends and loaded in the centre so that the plates become straight.
- Such a spring has 12 plates each 65mm wide by 6mm thick and the longest plate is 0.8m long. The greatest bending stress is not to exceed 185MN/m^2 and the central deflection when the spring is fully loaded is not to exceed 20mm. Determine the magnitude of the greatest central load that can be applied to the spring
Take $(E=200\text{GN/m}^2)$.

(20 marks)

QUESTION 5

- An open-coiled spring carries an axial load W . derive expressions for displacement and angular twist of the free end. (12 marks)
- For an open-coiled spring of helix angle 30° , determine the mean radius to give a vertical displacement of 23 mm and an angular rotation of the load end of 0.02 radians under an axial load of 35N. The material available is steel rod 6 mm diameter.

(8 marks)

Take $E = 200,000 \text{ N/mm}^2$; $G=80 \text{ N/mm}^2$.