TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

Department of Mechanical & Automotive Engineering

UNIVERSITY EXAMINATION FOR:

BSc. Mechanical Engineering

EMG 2403: SOLID AND STRUCTURAL MECHANICS III

SUPPLEMENTARY EXAMINATION

SERIES: SEPT. 2017

TIME: 2 HOURS

DATE: SEPT. 2017

Instruction to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. All questions carry EQUAL marks attempt any **THREE** questions.

Do not write on the question paper.

Question ONE

Fig Q1 shows a steel bracket in the form of a curved beam of I cross-section with all the dimensions indicated as functions of $'a'$. The bracket is subjected to a tensile load W.

(i) Derive expressions for the maximum tensile stress and maximum compressive stress at section $x-x$, in terms of the indicated parameters.

(ii) If the limiting stresses in tension and in compression are respectively $320MN/m^2$ and $200MN/m^2$, calculate the acceptable value of W.

Question TWO

Fig Q2 shows a cylinder made of Material 1, having outside diameter $360mm$ and shrink-fitted onto a rod of diameter $180mm$ and made from Material 2.

(a) If a Hoop stress of magnitude $62MN/m^2$ is produced on the outer surface of the cylinder, sketch the distribution of the Hoop stress across the cylinder thickness.

(b) If the overall temperature is increased by 40^0C,calculate the resultant Hoop stress on the inner surface of the cylinder (Material 1).

$E_1 = 240MN/m^2$; $\nu_1 = 0.32$; $\alpha_1 = 16\times10^{-6}/^0C$

$E_2 = 160MN/m^2$; $\nu_2 = 0.36$; $\alpha_2 = 23\times10^{-6}/^0C$

Question THREE

Fig Q3 shows the cross-section of a cantilever beam of length $20a$. The beam supports a vertical upward acting load W at the free end.

(i) Derive in terms of the indicated parameters expressions for the maximum tensile stress and the maximum compressive stress at the fixed end of the beam.

(ii) If $a = 80mm$ and if the limiting stresses in tension and in compression are respectively $320MN/m^2$ and $240MN/m^2$, calculate the maximum value of W that can be applied on the beam.

Question FOUR

Fig Q4 shows a thin – walled structure, fixed at the left-hand end (Point A) and at point C it is attached to a block that is constrained to move in a horizontal direction by two smooth horizontal surfaces. The cross-section of the structure is rectangular in cross-section with breadth 'b' and thickness 't'. If a horizontal force W is applied to the block at point C

(i) calculate the reaction force on the smooth surfaces

(ii) derive an expression for the horizontal deflection of the block (point C) in terms of the indicated parameters.

Question FIVE

A steel hollow cylinder has outside diameter $960mm$ and inside diameter $400mm$. Calculate the required speed of revolution necessary for the thickness to change by $0.08mm$.

$E = 200GN/m^2$; $\nu = 0.29$; $\rho = 7560kg/m^3$

Use the following equations:

$$\sigma_r = A - \frac{B}{r^2} - \left(\frac{3+\nu}{8}\right)\rho w^2 r^2$$

$$\sigma_H = A + \frac{B}{r^2} - \left(\frac{1+3\nu}{8}\right)\rho w^2 r^2$$

Where A and B are constants, ν the Poisson's ratio , ρ the density of the material and E the Modulus of Elasticity of the material.

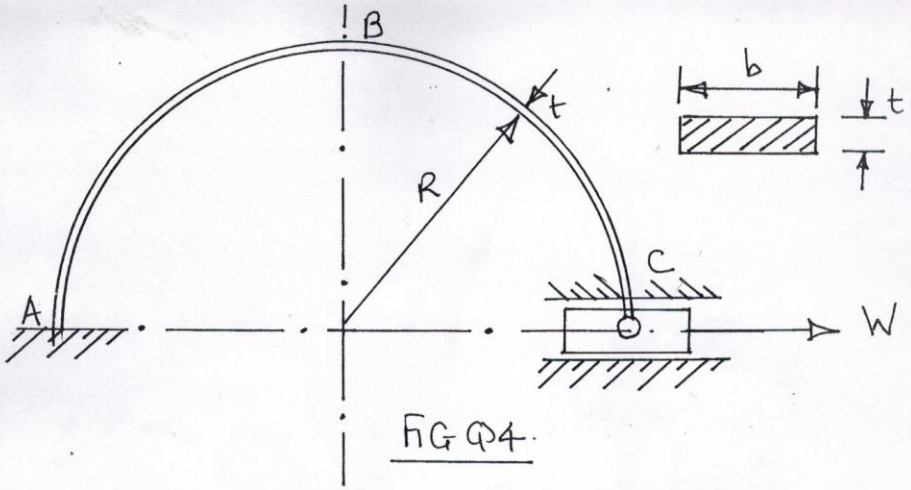

FIG Q4.

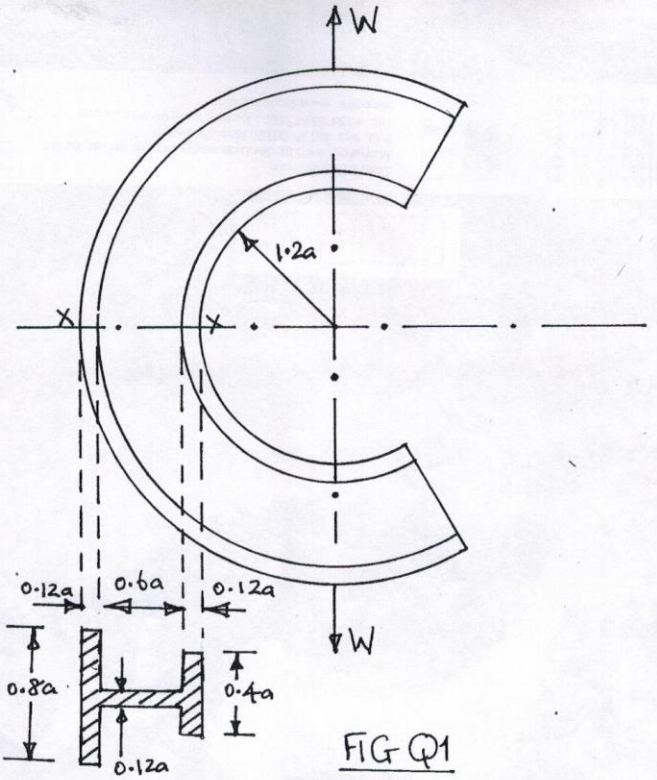

FIG Q1

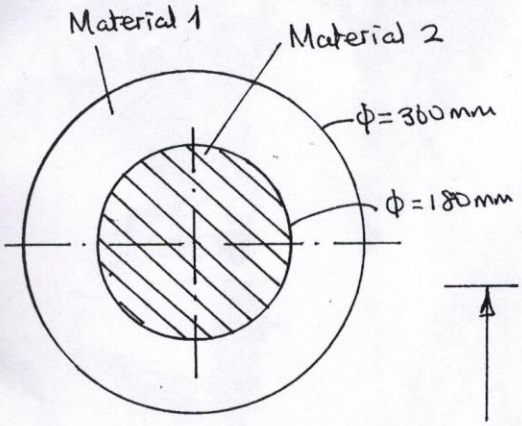

FIG Q2

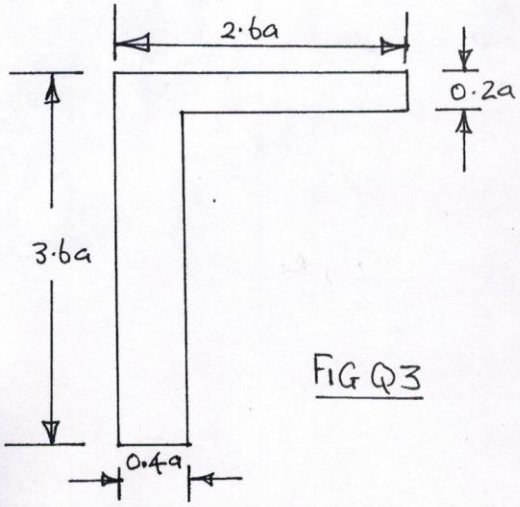

FIG Q3