TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
BSc. Mechanical Engineering
EMG 2403: Solids & Structural Mechanics III
SUPPLEMENTARY EXAMINATION
SERIES: September 2018
TIME: 2 HOURS

Instruction to Candidates:

You should have the following for this examination

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

This paper consists of **FOUR** questions. Attempt any **THREE** questions.
Maximum marks for each part of a question are as shown.
Do not write on the question paper.

Question ONE

A steel cylinder of outside diameter $102mm$ is shrink-fitted onto a bronze rod of diameter $64mm$ and the two materials are in contact over a length a length of $60mm$. A hoop stress of magnitude $92MN/m^2$ occurs at the outer radius of the steel cylinder.

(i) Calculate the contact pressure between the steel cylinder and the bronze rod, and calculate also the force that would be needed to pull out the steel cylinder from the bronze rod.

(ii) Calculate the difference in diameters of the mating surfaces before assembly.

$E_{steel} = 200GN/m^2$ $\upsilon_{steel} = 0.29$

$E_{bronze} = 100GN/m^2$ $\upsilon_{bronze} = 0.34$

$\mu_0 = 0.3$

E = Modulus of Elasticity of the materials

υ = Poisson's ratio of the materials

μ_0 = Coefficient of friction between the two surfaces

Question TWO

Fig Q2 shows a bracket in the form of a curved beam, fixed at the top and supporting a point load W as well as an anti-clockwise couple of magnitude $1.6Wa$. The cross-section of the beam is also indicated with the dimensions given as functions of 'a'. Derive expressions for the Maximum Tensile Stress and the Maximum Compressive Stress at section $x-y$.

Question THREE

Fig Q3 shows a cross-section of a cantilever beam of length $16a$ fixed at one end and supporting a vertical downward acting load of magnitude W at the free end.
Derive expressions for the Maximum Tensile Stress and the Maximum Compressive Stress at the fixed end.

Question FOUR

A steel rotor of outside diameter $800mm$ and inside diameter $400mm$ has rotor blades evenly distributed on the outside diameter, each with a mass of $0.1kg$ and at an effective radius of $450mm$. If while rotating at a speed of $3000rpm$, a maximum Hoop Stress of $380MN/m^2$ is obtained, calculate the number of blades on the rotor.
The expressions for the variation of the Radial Stress (σ_r) and Hoop Stress (σ_H) are given by the relationships:

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

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

where A and B are constants, $E = 200GN/m^2$; $\rho = 7830kg/m^3; \upsilon = 0.3$

E = Modulus of Elasticity of the material

ρ = Density of the material

υ = Poisson's ratio of the material

Question FIVE

Fig Q5 shows a beam of thin cross-section, breadth 'b' and thickness 't', fixed at the top and supporting a load W at the free end. The load is applied on a block that is constrained to move in a vertical direction by vertical guides with smooth surfaces. If $b = 20mm$, $t = 6mm$, $R = 200mm$ and $W = 120N$, calculate the magnitude of the vertical deflection $E = 210GN/m^2$

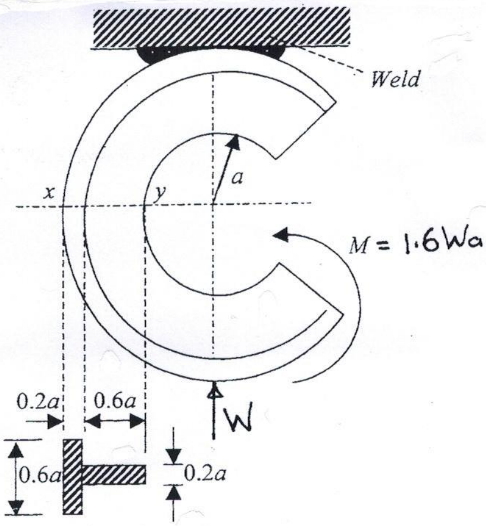

FIG Q2

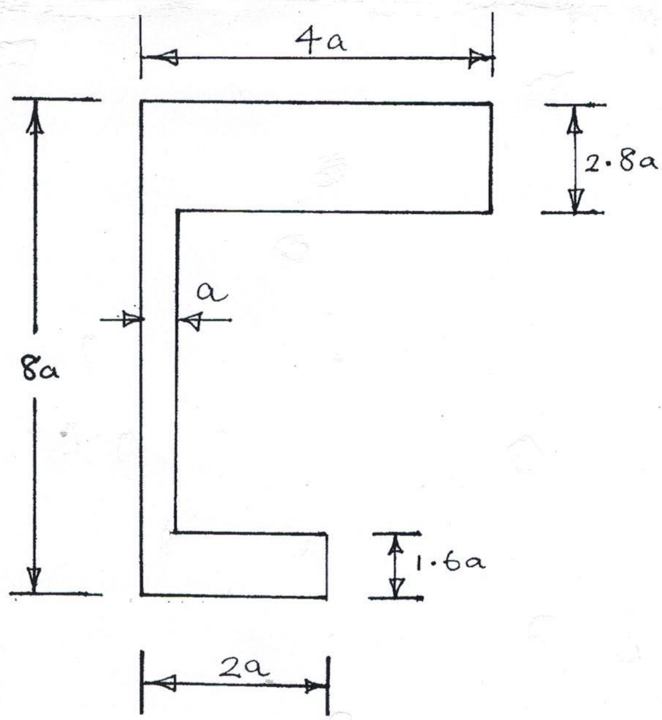

FIG Q3

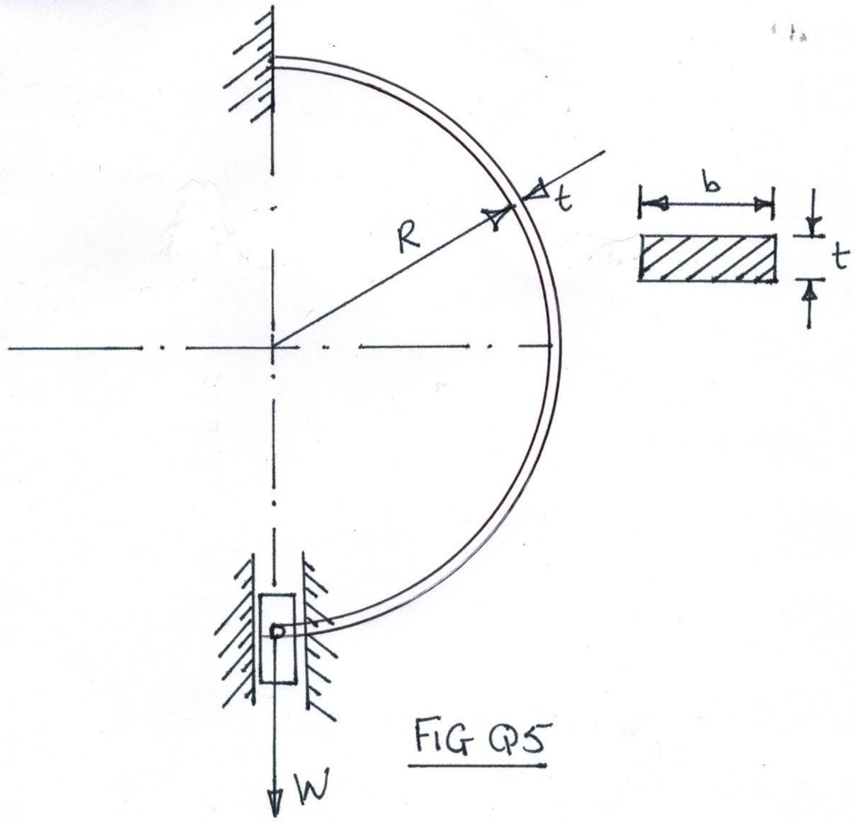

FIG Q5