FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2403 : SOLID & STRUCTURAL MECHANICS III

END OF SEMESTER EXAMINATION

**SERIES:** DECEMBER 2016

**TIME:** 2  HOURS

**DATE:** Pick Date Dec 2016

**Instructions to Candidates**
You should have the following for this examination
   -*Answer Booklet, examination pass and student ID*
This paper consists of **FIVE** questions. Attempt any THREE questions.
**Do not write on the question paper.**

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**Question ONE**

A solid steel propeller shaft 600 mm. in diameter is rotating at 300 R.P.M.  If the shaft is constrained at its ends so that it cannot expand or contract longitudinally, (i.e strain is zero) calculate the total longitudinal force over a cross section of the shaft due to rotational stresses.                                              (20 Marks)

 Assume $\rho = 8000 kg/m^3$   and  $\vartheta = 0.3$.

**Question TWO**

A steel sleeve of length and external diameter both 120 mm is shrunk onto a steel shaft of 80 mm diameter. The interference between the sleeve and the cylinder is such that the maximum hoop stress induced in the sleeve is 130 MN/m².                                              (20 marks)

Determine       (i) the minimum hoop stress in the sleeve

                (ii) the interference shrinkage pressure

(iii) The maximum shear stresses in the sleeve and shaft.

## Question THREE

The ring shown in Fig Q3 is made up flat steel strip 20mm x 3mm and is shaped in the form of a circle of men diameter 0.2 m. The ends at B are cut square and not joined. A pull P is applied along the diameter CD which is at right angles to the diameter AB. If the maximum tensile stress due to P is 125 MN/m$^2$ , find the increase in the opening at B due to P. E = 200GN/m$^2$.                                                   (20 marks)

## Question FOUR

The angle section shown in FigQ4 is subjected to a positive bending moment of 2kNm about the Z-axis. Determine the stress at points A, B and C and the position of the neutral axis. All units are in mm.
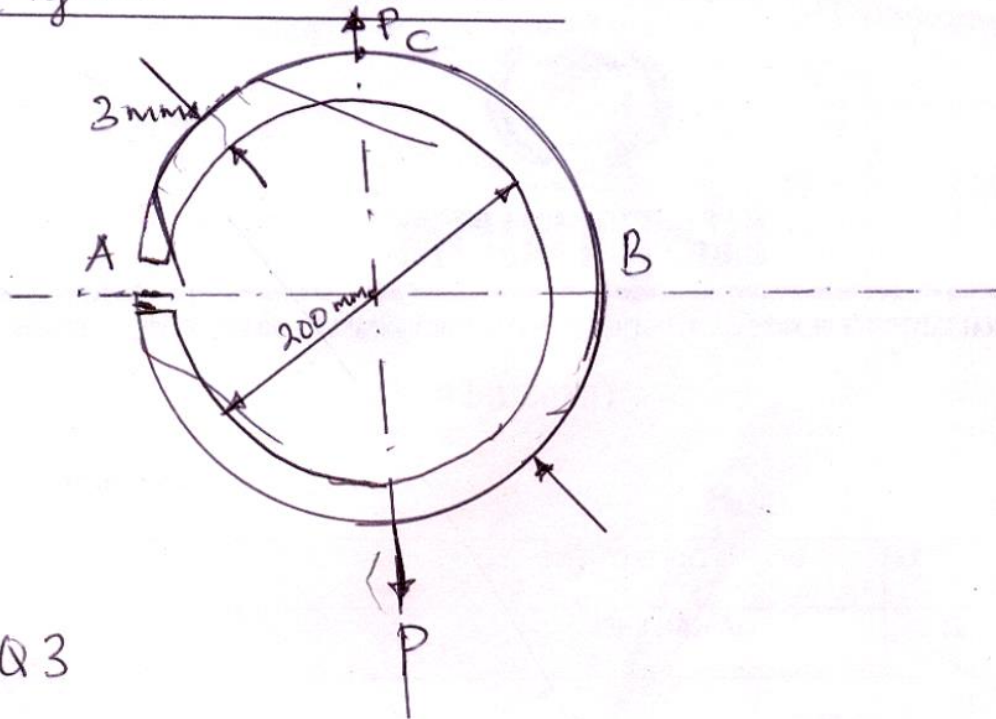                                                   (20 marks)

## Question FIVE

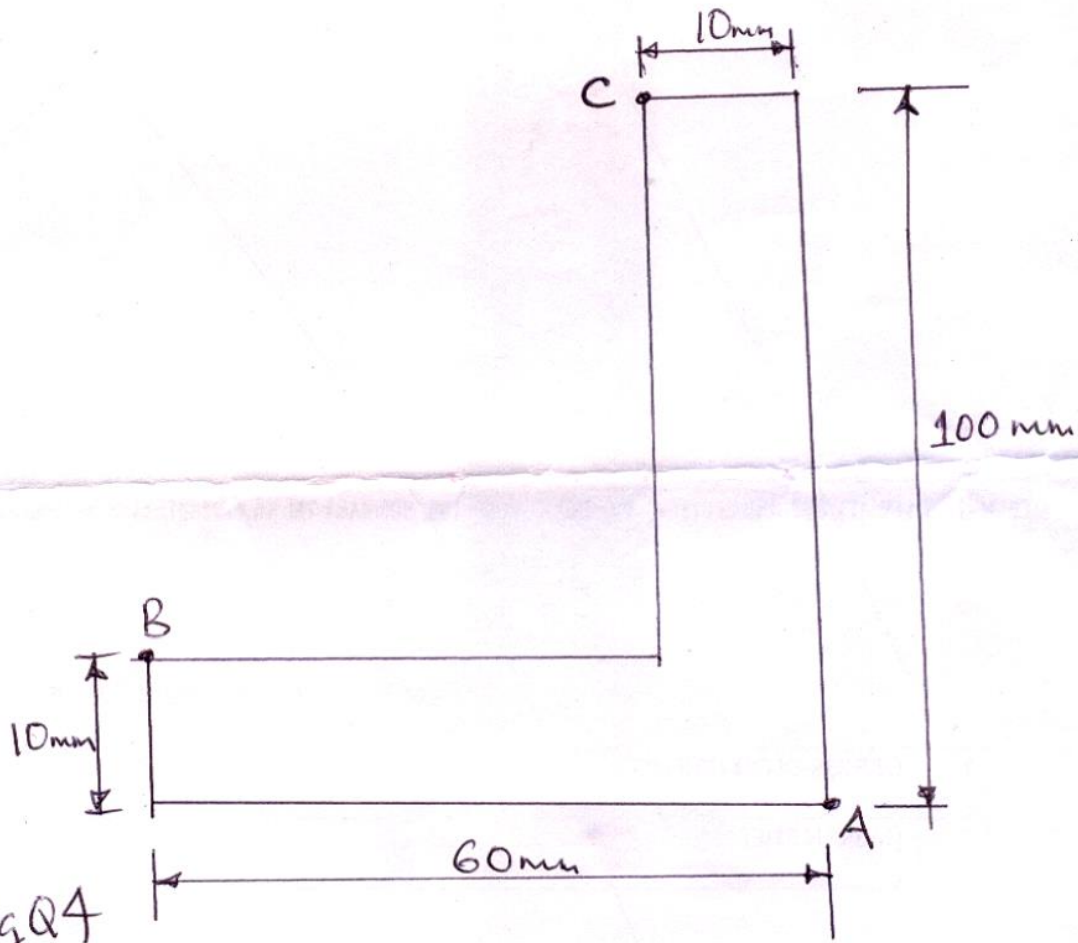a) Show that the shape factor, f, of a fully  plastic condition in a rectangular section is

   f = 3/2.                                                   (10 marks)

b) An 8cm x 3 cm rectangular bar is used as a simply supported beam on a span of 1.2 m and loaded at mid span. The yield stress is 275MPa and the long edges of the section are vertical. Assuming that after yielding the stress remains constant at 275 MPa, determine the load required to cause yielding for a depth 1 cm at the top and bottom of the section at mid span.                                                   (10 marks)

Figures EMG 2403



3 mm

P

C

A

200 mm

B

P

FigQ 3



10mm

C

100 mm

B

10mm

A

60mm

FigQ4