NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelor of Engineering (Hons) Degree Industrial and Manufacturing Engineering

SOLID MECHANICS II

TIE 2203

Second Semester Main Examination Paper

April/May 2015

This examination paper consists of four (4) printed pages

Time Allowed: **3 hours**

Total Marks: **100**

Special Requirements:

Examiner's Name: **Mr. N Tayisepi**

INSTRUCTIONS AND INFORMATION TO CANDIDATE:

1. Answer any five (4) questions.
2. Each question carries 25 marks.
3. Use of calculators is permissible.

QUESTION 1

A compound cylinder is formed by shrinking a tube of 250 mm internal diameter and 25mm wall thickness onto another tube of 250 mm external diameter and 25 mm thick, both tubes being made from the same material. The stress set up due to shrinkage is 10 MN/m^2. The compound tube is then subjected to an internal pressure of 80 MN/m^2. Compare the hoop stress of the compound cylinder to that of a single cylinder of 300 mm external diameter, 50 mm thick subjected to the same internal pressure. **[25]**

QUESTION 2

Calculate the stress set up at points A, B and C for the cantilever of the cross-section shown below in Figure Q2, which measures 1.5 metres long and carries a 15KN load at its outer end, the line of action being parallel to the longer leg and arranged to pass through the shear centre of the section. **[25]**

$I_{xx} = 4x10^{-6}\ m^4$ and $I_{yy} = 1.08x10^{-6}\ m^4$

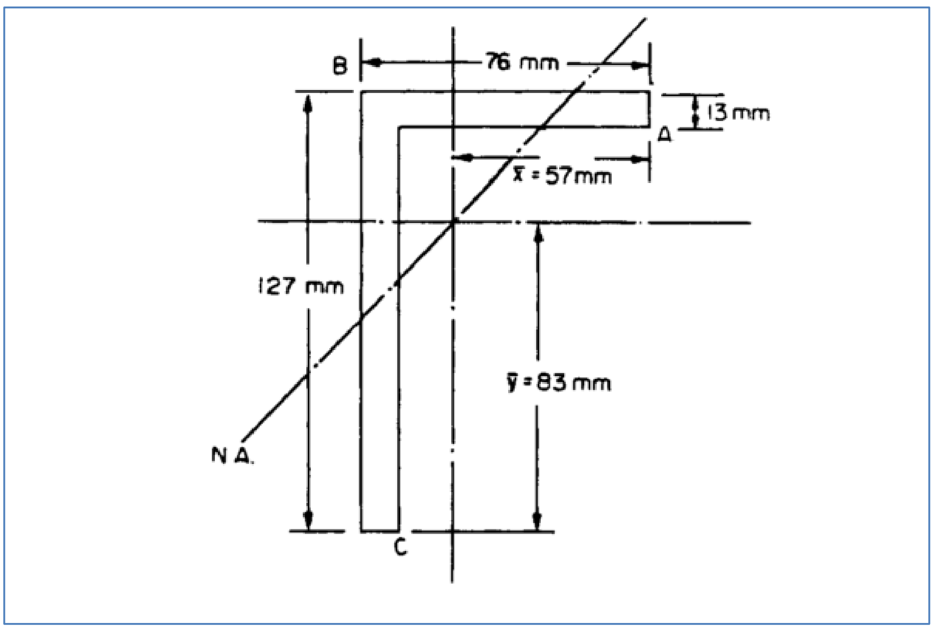

Figure Q2

QUESTION 3

Compare the torsional stiffness and maximum stress setup for the following cross sections which can be assumed to be of unit length:

(a) a hollow tube diameter 50 mm and 2 mm wall thickness **[7]**

(b) the same tube with a 2 mm wide saw cut along its length **[7]**

(c) a rectangular solid bar, side ratio 4:1 having same cross section area as that enclosed by the mean diameter of the hollow tube **[5]**

(d) a square box section having the same perimeter and thickness as the tube **[6]**

QUESTION 4

A thick cylinder 100 mm external diameter and 50 mm internal diameter is wound with a steel wire 1mm diameter initially stressed to 20 MN/m^2 until the outside diameter is 120 mm. Determine the maximum hoop stress set up in the cylinder if an internal pressure of 30MN/m^2 is now applied. **[25]**

QUESTION 5

Determine the maximum compressive stress set up in a 200 x 60 mm I-section girder carrying a load of 100 kN with an eccentricity of 6 mm from the critical axis of the section. Assume the ends of the strut to be pin-jointed and the overall length is 4 m.

$\mathbf{I_{yy} = 3 \times 10^{-6}\ m^4;\ A = 6 \times 10^{-3}\ m^2;}$ $E = 207\ GN/m^2$ **[25]**

QUESTION 6

Under certain loading conditions, the stresses in the walls of a cylinder are found as follows:

(i) 90MN/m² tensile,

(ii) 40 MN/m² tensile at 90° to the 90 MN/m² tensile stress above.

Shear stress of 50MN/m² on the planes on which the stresses a and b act; the shear couple acting on planes carrying the 40MN/m² stress is clockwise in effect
Calculate,

(a) the principal stresses, **[8]**

(b) the angles at which they act, **[7]**

(c) the normal stress on the plane of maximum shear, **[5]**

(d) the maximum shear stress. **[5]**

END OF EXAMINATION