TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING (DMEN)

EME 2204
SOLID & STRUCTURAL MECHANICS I

END OF SEMESTER EXAMINATIONS

YEAR 2 SEMESTER 1

SERIES: DECEMBER, 2013

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. All Questions carry equal marks.
5. **This paper consists of THREE printed pages.**

Question ONE

A copper tube has it's ends closed by washers held in place by a pair of steel bolts. The bolts are initially tightened to give rise to a stress of 40.7MN/m^2 in each bolt. The temperature of the assembly is hen lowered by 30^{o}C. From the above information:

(i) Sketch the assembly
(ii) Determine the forces in copper and steel bolts before change in temperature
(iii) The resultant stresses in steel and cooper after temperature change

The tube has internal diameter of 120mm and thickness of 6mm, the bolts are 25mm in diameter:

$\alpha_c = 18\times10^{-6}/°C$ $\alpha_s = 16\times10^{-6}/°C$

$EC = 100GN/m^2$ $E_s = 200GN/m^2$

(20 marks)

Question TWO

(a) Given that a thin cylinder has an internal pressure 'p', internal diameter 'd', wall thickness 't', and length '*l*' derive formulae showing the relationship between:

(i) Circumferential stress $'\delta_c'$ and diameter, thickness, and internal pressure.

(ii) Longitudinal stress $'\delta_l'$ and diameter, thickness, and internal pressure.

(8 marks)

(b) A cylinder is 150mm mean diameter, 750mm long with wall thickness of 2mm. It has an internal pressure of 0.8MPa. Determine:

(i) $'\delta_l'$

(ii) $'\delta_c'$

(iii) Change in cross-section
(iv) Change in length
(v) Change in volume

Take $\upsilon = 0.28, \quad E = 200GN/m^2$

(12 marks)

Question THREE

A beam of total length 15m is simply supported at the left and rests on a frictionless roller located 5m from the right hand end. The beam carries a uniformly distributed load of 150KN/m over its entire length together with a point load of 1000N located 5m from the L.H.E and another point load of 400N located 2.5m from the R.H.E. For the beam:

(i) Calculate the reactions
(ii) Sketch neat shearforce and bending moment diagrams, and on each diagram indicate maximum values of S.F and B.M.

(20 marks)

Question FOUR

A simply supported beam of 'I' section carries a load of 200N at the centre the beam has a span of 6m. The 'I' cross-section of the beam has the following dimensions. Top flange = 60 x 10mm deep. Bottom flange = 40 x 10mm deep: web = 10mm thick x 30 mm deep. From the above information:

(i) Calculate the 2nd M.O.A in (m^4).
(ii) Calculate the maximum bending moment
(iii) Stress on top and bottom face
(iv) Sketch the stress distribution of the section

(20 marks)

Question FIVE

A composite beam consist of a timber beam 200 x 300mm deep strengthened by bolting steel plates 10 x 250mm deep on the sides of the timber beam flushing both bottom sides of the timber and steel respectively. If the maximum stresses of the steel and timber must not exceed 85 and 5.5MN/m^2 respectively. Determine the maximum bending moment in the beam. **(20 marks)**