University of Swaziland
Faculty of Science and Engineering
Department of Electrical and Electronic Engineering

Main Examination 2016

Title of paper: **Engineering Mechanics and Materials Science**

Course Number: **EEE201/EE201**

Time allowed: 3 hours

Instructions:
1. Answer any FOUR (4) questions
2. Each question carries 25 marks
3. Marks for each question are shown at the right hand margin

This paper contains 4 pages including this one.

This paper should not be opened until permission has been granted by the invigilator.

Question 1

a) Define the following terms
   i)   Direct Stress   [2 marks]
   ii)   Shear stress   [2 marks]
   iii)   Thermal stress   [2 marks]
   iv)   Strain   [2 marks]
   v)   Shear strain   [2 marks]

b) In **Figure 1** below the force F is 36 N, L is 4 m and the diameter of the rod is 30mm. for given that the young's modulus for steel is 210 GPa and for aluminium is 69 GPa. For each of the elements, find the following:
   i)   The stress
   ii)   The stretched length x
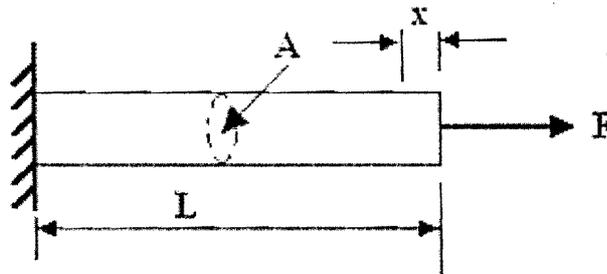   iii)   The strain   [15 marks]

Figure 1

Question 2

In the diagram **Figure 2** below, the pin-jointed structure supports a block **E** of weight 14.4 N by a Pulley D. the distances AF = 150, FC = 50, BC = 150, and CD = 300. Neglecting the weights of the members of the structure;

a) Draw the free body diagrams of each member of the structure and show all the forces acting at points A, F, C, B, D.   [8 marks]

b) Determine the vertical and horizontal components, and the magnitudes of the resultant forces at pin joints A, and C, and on member AFC.   [17 marks]
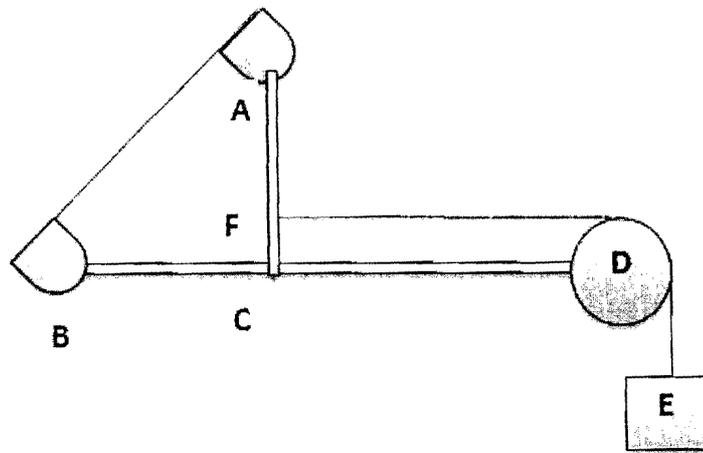
Figure 2

Question 3

If the solid cylinder shown in **Figure 3** weighs 2kN, its radius r is 60 cm, and its centroidal moment of inertia Ic is 500m.N.sec^2. It rolls without slipping down the incline. Assume rolling friction to be negligible and g = 9.806 m/s

a) Draw the free body diagram   [5 marks]

b) Write the expressions of all the forces acting on the cylinder   [5 marks]

c) Calculate

     i)   The translational acceleration $\ddot{x}$ [8 marks]

     ii)   The angular acceleration $\ddot{\theta}$ [3 marks]
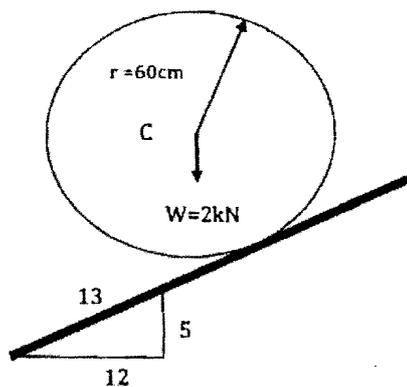
     iii)   The friction force **F**   [4 marks]

Figure 3

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Question 4

Briefly describe the following properties of materials and give equations related to each property where possible

    a) Ductility   [4 marks]
    b) Stiffness   [4 marks]
    c) Density   [4 marks]
    d) Thermal expansion   [4 marks]
    e) Hardness   [3 marks]
    f) Tensile strength   [3 marks]
    g) Toughness   [3 marks]

Question 5

    a) Give two types of Alloys   [2 marks]
    b) List and describe 3 examples of steels   [9 marks]
    c) List and describe 3 examples of cast irons   [9 marks]
    d) Give two examples of copper alloys and their uses   [5 marks]