# UNIVERSITY OF SWAZILAND

### FACULTY OF SCIENCE & ENGINEERING

## DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

### MAIN EXAMINATION, FIRST SEMESTER DECEMBER 2013

TITLE OF PAPER:	ENGINEERING MECHANICS AND MATERIALS SCIENCE
COURSE CODE:	EE201
TIME ALLOWED:	THREE HOURS

### **INSTRUCTIONS:**

# 1. Answer any four (4) questions

2. Each question carries 25 marks.

3. Marks for different sections are shown in the right-hand margin.

# THIS PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

1

This paper has 4 pages including this page.

#### **Question 1**

Determine the reactions ( $R_A$  and  $R_B$ ) and the stresses in members AE, ED, and BD of the roof truss shown in Figure 1. (25 marks)



### **Question 2**

- (a) Figure 2 shows a hand cart weighing 800 N, and each axle ( pair of wheels) is designed to support a maximum force of 10 kN, determine the largest weight W that may be supported and the position d where it should be placed, assuming both axles are loaded to their capacity.

   (10 marks )
- (b) Draw bending moment diagram for this hand cart when supporting the maximum weight. (15 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  $I_c$  is 500m.N.sec<sup>2</sup>. 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) At time t = 2 second and by using impulse-momentum method, calculate the linear acceleration *a* of its center of gravity and friction force F. (20 marks)



### **Question 4**

- a) What are the two types of material property charts, and what the three reasons that makes these tools important? (12 marks)
- b) A boat's propeller shaft transmits 40kW at 120 rev/min.
  - Determine
  - 1) the torque on the shaft
  - 2) the minimum diameter (in centimetres) of a solid circular section shaft, when the maximum permissible shear stress in the shaft is limited to 40MPa, and
  - 3) the resulting angle (in degrees) of twist of this shaft, due to torque, over a length of 1.4m, when the rigidity modulus is 40GPa. (13 marks)

### **Question 5**

Explain how electrical properties of materials are used in designing of electrical power transmission lines. (25 marks)