**Egerton University**

**December 2013**

**Instructions**

**Answer question one and any other two**

**Question One (30 marks) Compulsory**

1. What is a logic gate? [2 marks]
2. With the aid of a diagram explain the operation of an S-R flip-flop. Explain how the unwanted condition of setting S=R=1 can be eliminated. [5 marks]
3. Explain how the following are represented in a digital system;
4. Text
5. Numbers
6. Images

[6 marks]

1. Design a combinational circuit that complements an entire 8-bit binary string whenever activated by a control signal. A HIGH on the control signal causes the circuit to complement the 8-bit string and a LOW does not. Explain the operation of the circuit works.

[7 marks]

1. Carry out the following arithmetic operations;
2. 32**10** – 37**10** using two’s complement
3. 14**10** \* 14**10** in binary
4. 67**8** + 77**8** in binary
5. 8**10** + 9**10** using BCD
6. 16**16** + 4F**16** in binary

[10 marks]

**Question Two(20 marks)**

1. Explain two applications of multiplexers. [2 marks]
2. Differentiate between the following;
3. Ripple and Asynchronous counters
4. Digital and Analog signals

[4 marks]

1. With the aid of a diagram explain the operation of a 4 to 1 multiplexer. [4 marks]
2. Explain any two applications of BCD in digital circuits. [4 marks]
3. With the aid of a diagram describe how you can read signals from sensing elements through a serial port of a CPU. [6 marks]

**Question Three (20 marks)**

1. Define a binary counter and state any two areas of application. [3 marks]
2. With the aid of a diagram and waveforms explain the operation of a mod-8 ripple counter. [6 marks]
3. Design and explain the operation of a combinational circuit that counts the number of people entering a shop. State the assumptions made if any. [11 marks]

**Question Four (20 marks)**

1. Explain why hexadecimal and binary number systems popular with digital systems.

[2 marks]

1. Convert 236 to Gray code and state why the code is used for indicating shaft positions in rotating machines instead of pure binary. [4 marks]
2. With the aid of diagrams, explain how a logic pulser and logic probe are used in digital circuit trouble shooting. [6 marks]
3. A circuit with three inputs **a, b,** and **c** gives the following truth table with two independent outputs **x** and **y**. Implement the simplified expressions for **x** and **y**.

**Inputs Outputs**

**a b c x y**

0 0 0 0 0

0 0 1 1 0

0 1 0 1 0

0 1 1 0 1

1 0 0 1 0

1 0 1 0 1

1 1 0 0 1

1 1 1 1 1

 [8 marks]

 **Question Five (20 marks)**

1. What is the difference between combinational and sequential logic? [2 marks]
2. State the similarities and application of the following;
3. Truth table
4. Karnaugh Map

[4 marks]

1. Explain any three reasons for digital circuit minimization. [6 marks]
2. Implement a simplified expression for X = $\overline{A}$ $\overline{B}$C + $\overline{A}$ $\overline{B}$ $\overline{C}$ + $\overline{A}$ B $\overline{C}$ by using NAND gates only. Explain any two disadvantages of using NAND gates for implementing the expression.

 [8 marks]