



# THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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**MAIN EXAMINATION**

**JANUARY – APRIL 2015 TRIMESTER**

**FACULTY OF SCIENCE**

**DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE**

**REGULAR PROGRAMME**

**CMT 201: LOGIC CIRCUITS**

<b>Date: APRIL 2015</b>	<b>Duration: 2 Hours</b>
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<b>Instructions: Answer Question ONE and any other TWO Questions.</b>
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Q1. a) Define the following terms as used in number systems.

**(6 marks)**

- i) Most significant Bit (MSB)
- ii) Least significant Bit (LSB)
- iii) Encoding
- iv) Signed – magnitude representation
- v) One's complement representation
- vi) Two's complement representation

b) i) Add the binary numbers: **(2 marks)**

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0 1 1 0 1 0 1 0
1 0 0 0 0 0 0 1
1 1 1 1 1 1 1 1
0 0 0 0 1 0 0 0
```

ii) Divide 1110101 by 1001 **(2 marks)**

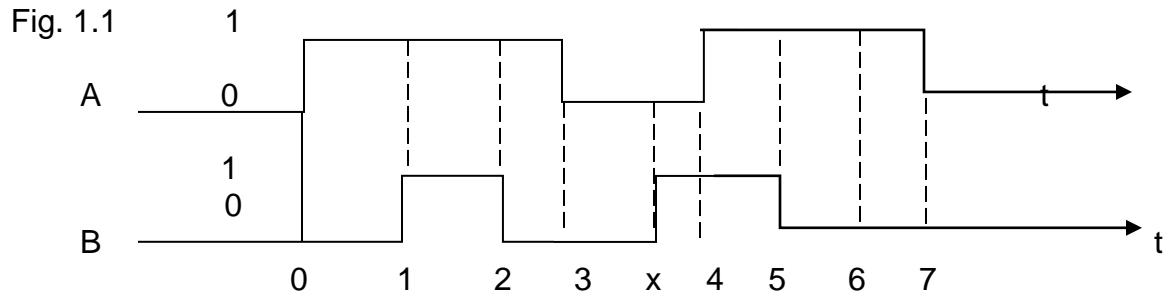
iii) Convert the following decimal numbers into hexadecimal numbers.

- A) 95.5 **(2 marks)**
- B) 675.625 **(2 marks)**

c) Explain what a Boolean equation is. Hence, use a Boolean equation to work out the following: you have rented a locker in a bank. Express, the process of opening the locker in terms of a digital operation.

**(3 marks)**

- d) What will be the output of a 2-input NAND gate, if one of its inputs is permanently connected to
- i) logic 0 voltage **(2 marks)**
  - ii) logic 1 voltage **(2 marks)**
- e) i) Distinguish between a minterm and a maxterm. **(2 marks)**
- ii) Convert  $Y = AB + A\bar{C} + BC$  into canonical SOP form. **(4 marks)**
- f) What are Karnaugh Maps. Account for their importance in Boolean functions. **(3 marks)**
- Q2. a) Find the two's complement of the numbers below.
- i) 01100100
  - ii) 10010010
  - iii) 11011000
  - iv) 01100111
- (8 marks)**
- b) Perform the following operations using 2's complement method.
- i)  $7 - 5$
  - ii)  $5 - 7$
  - iii)  $48 - 23$
  - iv)  $48 - (-23)$
  - v)  $-48 - 23$
- (10 marks)**
- c) What is an overflow? **(2 marks)**
- Q3. a) Convert, showing the necessary steps, the following numbers into the system indicated.
- i)  $(6327.4051)_8$  into decimal number. **(3 marks)**
  - ii)  $(3287.5100098)_{10}$  into octal **(4 marks)**
  - iii) 1100110001.00010111100 into octal **(3 marks)**
- b) Describe the following types of binary codes; straight binary code, natural BCD Code, Excess – 3 code and Gray code. **(10 marks)**
- Q4. a) The voltage waveforms shown in fig.1.1 below are applied at the inputs of a 2-input AND gate. Determine the output waveform. **(10 marks)**



- b) The voltage waveforms shown in fig.1.1 above are now applied at the inputs of an EX – OR gate instead of AND gate. Determine the output form.

**(10 marks)**

- Q5. a) Design a digital circuit for the logic equation

$$Y = \bar{A}.B + A.\bar{B}$$

**(6 marks)**

- b) Given the logic equation

$$Y = (A + BC)(B + \bar{c}A)$$

- i) Design a circuit using gates to realize this function.

**(6 marks)**

- ii) Find out whether its possible to design the circuit with only one type of gates (NAND or NOR) If yes, design the circuits.

**(8 marks)**

**\*END\***