



# TECHNICAL UNIVERSITY OF MOMBASA

## INSTITUTE OF COMPUTING AND INFORMATICS

### DEPARTMENT OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY

#### UNIVERSITY EXAMINATION FOR:

(BTIT14S J-FT & BSIT 14S J-FT)

ICS 2205: EEE 4250: DIGITAL LOGIC & DIGITAL ELECTRONICS

END OF SEMESTER EXAMINATION

**SERIES: APRIL 2016**

**TIME: 2 HOURS**

**DATE: Pick Date May 2016**

#### Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

**Do not write on the question paper.**

#### Question ONE

- a) State and prove De Morgan's theorem. (8 Marks)
- b) Differentiate between the following terms
- Basic logic gates and Universal logic gates
  - Combinational circuits and sequential circuits
  - Level triggered and edge triggered (6 Marks)
- c) Prove using the truth table  $\overline{A \cdot B} + A \cdot \overline{B} + A \cdot B = A + B$  (4 Marks)
- d) Perform the following arithmetic using 2's complement
- $36 + 24$
  - $43 - 34$
  - $36 - 42$  (6 Marks)
- e) Design and implement a 3-bit majority function. (6 Marks)

## Question TWO

- a) Design the logic circuit of a 2 bit comparator to give the greater than, equality and less than functions at the output. (14 Marks)
- b) Using NAND gates only implement the equality function. (6 Marks)

## Question THREE

- a) Design the logic circuit of a full adder circuit. (8 Marks)
- b) Using the full adder implement a 4-bit adder circuit (6 Marks)
- c) Provide the additional logic gates that may be included to convert the full adder circuit to a 4 bit adder/subtract circuit. (6 Marks)

## Question FOUR

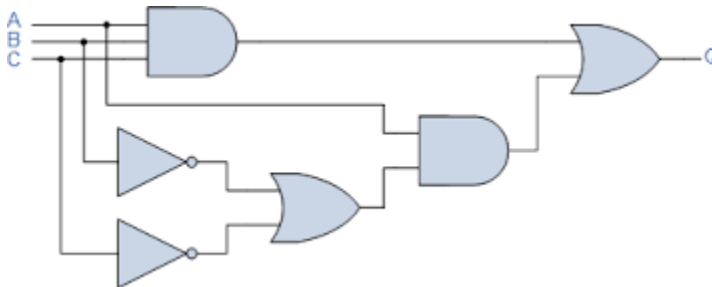
- a) Use Boolean Identities to simplify

i)  $X = \bar{A} \cdot \bar{B} \cdot \bar{C} + \bar{A} \cdot \bar{B} \cdot C + A \cdot \bar{B} \cdot \bar{C} + A \cdot \bar{B} \cdot C$

ii)  $Y = (A + \bar{B} + \bar{C}) \cdot (A + \bar{B} \cdot C)$

iii)  $Y = \overline{(A + B \cdot A) + (C + D + E \cdot \bar{C})}$  (9 Marks)

- b) The logic circuit below implements the function Q.



- i. Generate the Boolean expression for the function Q
- ii. Simplify the expression for Q
- iii. Implement using NAND gates only (11 Marks)

## Question FIVE

- a) Describe the operation of a J-K flip flop. (6 Marks)
- b) Using a J-K flip flop construct a 4-bit counter. (6 Marks)
- c) Show the additional logic that need to be added to build a module 10 counter.  
(4 Marks)
- d) Describe propagation delay and the hazards associated with the delay. (4 Marks)