LAIKIPIA UNIVERSITY

# UNIVERSITY EXAMINATIONS

## SECOND SEMESTER 2023/2024 ACADEMIC YEAR

## SECOND YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN (ICT)

## BICT 222: DIGITAL LOGICS

***STREAM: R*** ***TIME: 2 HRS***

***DAY:WEDNESDAY[2.30 – 4.30 P.M]*** ***DATE: 10/04/2024***

**THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES**

**PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.**

**INSTRUCTIONS**: Section A is compulsory and has **30 marks**.

Attempt any **TWO** questions from Section B. Each question has **20 marks.**

**Section A – 30 marks (Answer all questions)**

**QUESTION ONE (30 MARKS)**

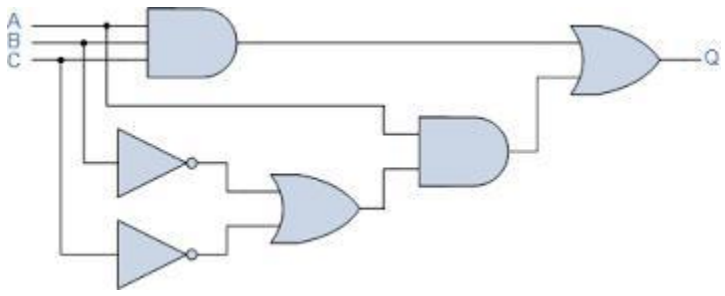
1. State and prove De Morgan's theorem. **(2 Marks)**
2. Differentiate between the following terms **(4 Marks)**
    a. Combinational circuits and sequential circuits
    b. Level triggered and edge triggered
3. Minimize the expression: $AB+AC'+BC$ using the theorem and properties of Boolean algebra. **(3 Marks)**
4. Using **(3 Marks)**
    a. 1's complement, subtract (1000100-1010100).
    b. Using 9's complement, subtract (3250 – 72532).
    c. Using 10's complement, subtract (3250-72532).
5. Draw a logic gate that implements the following: **(4 Marks)**
    a. $F = AB + C\,D' + B'\,C$
    b. $F = (A + B)\,(B' + C)\,(C' + D + E)$
6. Perform the following operations: **(6 Marks)**
    a. $100.1B_{16}$ – $OFF.OD_{16}$ (Convert your answer to decimal)
    b. $275_8 + 57_8$ (Convert your answer to hexadecimal)
    c. Convert $(724.25)_8$ into octal
7. Draw a NAND gate realization of an edge triggered O flip flop and explin the operation of the flip flop. **(4 Marks)**
8. 
    a. Express the Boolean function F =XY+X′Z in a product of max term form. **(2 Marks)**
    b. Express the Boolean function F=A+B′C in a sum of min terms. **(2 Marks)**

**SECTION B – 40 MARKS (ANSWER ANY TWO QUESTIONS)**

**QUESTION TWO (20 MARKS)**

a) The logic circuit below implements the function

Q




**(12 Marks)**

i. Generate the Boolean expression for the function Q

ii. Simplify the expression for Q

iii. Implement using NAND gates only

b) Elucidate the following laws as espoused in digital systems **(8 Marks)**

i. Associative Law

ii. Distributive Law

iii. Inverse Law

iv. Identity Law

**QUESTION THREE (20 MARKS)**

a) Obtain a simplified expression for the K-map below and implement the simplified expression using logic gates **(6 Marks)**

b)

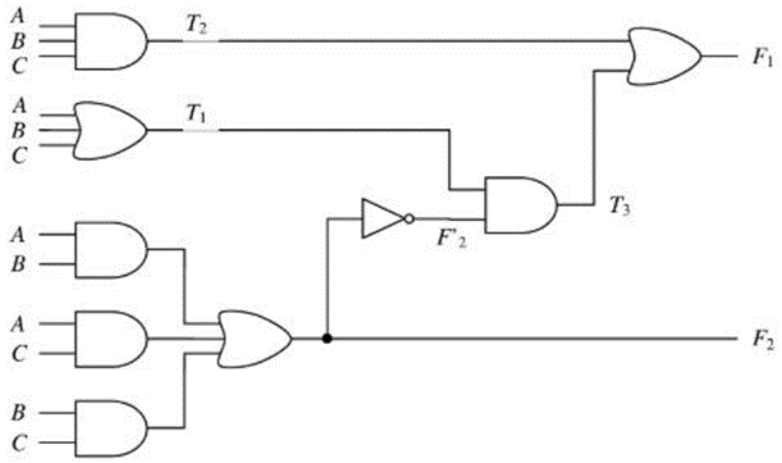
| Z / C \ A | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 1 | 1 |
| 01 | 1 | 0 | 1 | 1 |
| 11 | 0 | 0 | 0 | 0 |
| 10 | 1 | 1 | 1 | 1 |

| X / $B_3B_2$ \ $B_1B$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 1 | 1 |
| 01 | 1 | 1 | 0 | 0 |
| 11 | 1 | 1 | 0 | 0 |
| 10 | 0 | 0 | 1 | 1 |

c) Prepare K-Map for the given function **(4 Marks)**

$$f = AB + AC + B\bar{C}D$$

d) Obtaining Boolean functions and Truth table from logic diagram. **(5 Marks)**




e) Draw a logic circuit to implement a half odder, obtain the truth table. **(5 Marks)**

**QUESTION FOUR (20 MARKS)**

a) Draw a logic gates that implements the following: **(6 Marks)**

i. $F = AB + C\,D' + B'\,C$

ii. $F = (A + B)\,(B' + C)\,(C' + D + E)$

b) Simplify the following logic expression and draw the logic circuit for the simplified function **(4 Marks)**

i. $Y=(A+B)(A'+B')$

ii. $W=X.Y+X'.Y+X'Y'$

c) Design a 3 input majority function. The output is high if two or more inputs is high: **(6Marks)**

i. Show the truth table

ii. Derive the Boolean expression

iii. Implement using logic gates

d) With the aid of an illustration describe the two universal gates. **(4 Marks)**

**QUESTION FIVE (20 MARKS)**

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)**