**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**
**FACULTY OF ENGINEERING**
**ELECTRONIC ENGINEERING DEPARTMENT**
**DIGITAL ELECTRONICS**
**EEE 1214**

**Examination Paper**
**September 2024**

This examination paper consists of 3 pages

**Time Allowed: 3 hours**
**Total Marks: 100**
**Examiner's Name: Ndondo John W**

**INSTRUCTIONS**

1. Answer **All** Questions
2. Start the answer for each question on a fresh page

**MARK ALLOCATION**

| QUESTION | MARKS |
|---|---|
| 1. | **20** |
| 2. | **20** |
| 3. | **20** |
| 4. | **20** |
| 5. | **20** |
| | |
| **TOTAL** | **100** |

## Question 1

Perform the following conversions:

1.1 Convert the straight code binary $1100110001101.11011_2$ number into decimal number.

[4 points]

1.2 Convert the decimal number $631728_{10}$ into the straight code binary number.

[4 points]

1.3 Convert the straight code binary number $11101110011000111011 0_2$ into:

a. Octal number;
b. Hexadecimal number.

[4 points]

1.4 Convert the hexadecimal number $AC9052_h$ into decimal number.

[4 points]

1.5 Convert the decimal number $0.9872_{10}$ into octal number.

[4 points]

## Question 2

Perform the following arithmetic operations:

2.1 Add the straight code binary numbers $1100101111_2$, $10100110011_2$ and $111011001100_2$.

[4 points]

2.2 Use the 1s complement subtraction method to subtract the straight code the binary number $1010101_2$ from $10000011_2$.

[4 points]

2.3 Use the 2s complement subtraction method to subtract the straight code the binary number $1110000_2$ from $111010_2$ [4 points]

2.4 Simplify the following Boolean expression :

$$\left(\overline{A\overline{B}\overline{C}}\right)+\left(\overline{A\overline{B}C}\right)$$

[3 points]

2.5 For the given expression simplify to its sum of products (SOP) form,. Draw the logic circuit for the simplified SOP function.

$$Y=(A+B)(A+\overline{AB})C+\overline{A}(B+\overline{C})+\overline{A}B+ABC$$

[5 points]

## Question 3

Given the logic function **F** = Σ (0,1,2,3,10,12,13,15):

3.1 Show the truth table of the function; [5 points]

3.2 Obtain an expression for the function **F** in a sum of products form. [5 points]

3.3 Minimize the expression from 3.2 using Boolean algebra theorems. [5 points]

4.4 Prove the following Boolean identities using the laws of Boolean algebra:

(i) $(A + B)(A + C) = A + BC$ [2 points]

(ii) $ABC + ABC + ABC = A(B + C)$ [3 points]

## Question 4

4.1 What is a flip-flop? Write the truth table for the clocked J-K flip flop that is triggered by the positive going edge of the clock speed. Explain the operation of this flip flop for the following conditions :Initially all inputs are at zero and assume the Q output to be 1. [10 points]

4.2 With the help of a suitable diagram explain how you convert a JK flip flop to a T type flip flop [5 points]

4.3 With the help of a suitable diagram explain how do you convert a JK flip flop to a T type flip flop [5 points]

## Question 5

5.1 Define the term Demultiplexer [2 points]

5.2 Explain and design a 1 to 4 Demultiplexer [8 points]

5.3 What is a full adder? Explain a full adder with the help of a truth table and logic diagram [10 points]