TECHNICAL UNIVERSITY OF MOMBASA

School of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION 2024/2025

BACHELOR OF TECHNOLOGY IN ELECTRICAL AND ELECTRONI ENGINEERING

TEE 4206 : DIGITAL ELECTRONICS I

TIME: **2 HOURS** **SERIES:** April, 2025

INSTRUCTIONS TO CANDIDATES

1. You are required to have the following for these examinations:
   - Answer Booklet
   - Non Programmable calculator
2. This paper has **FIVE** Questions.
3. Answer question **ONE** and any other **TWO** questions.

Question ONE (COMPULSORY)

a) Design a logic circuit to perform Full adder function. **(10 marks)**

b) Perform the following operations
   i) 63_{10} - 41_{10} using 2's complement method
   ii) 856_{10} + 65_{10} using Excess-3 BCD **(5 marks)**

c) With the aid of a truth table, design even parity generator for a 3-bit code. Implement the function using basic gates. (**5 marks)**

Question TWO

a) Design a **THREE** input logic circuit that gives a High (1) when a majority of the inputs are Low. Implement using NAND gates **(9 marks)**

b) (i) State any **TWO** applications of Flip-flops
   (ii) With the aid of a truth table and logic diagram explain the operation of a J-K flip-flop. **(11 marks)**

Question THREE

a) Perform the following conversions:
   i) 725_8 to gray code
   ii) ADC_{16} to Octal
   iii) 10101001 gray to decimal **(8 marks)**

b) Obtain the results of the following operations in the respective base:
   i) $1001000_2 \div 110_2$
   ii) $55_8 \times 73_8$ (**5 marks**)

c) Define the following terms:
   i) Code
   ii) Radix **(4 marks)**

d) Find the minterm expression of $F = A\overline{B} + \overline{C}$ (**3 marks**)

Question FOUR

a) Sketch a block diagram of a 4 – to -1 multiplexer and derive its truth table. **(3 marks)**

b) Reduce the Boolean expression given by:

$$y = \overline{\overline{(\overline{A}B\overline{C} + \overline{A}BC)} + \overline{\overline{A}(\overline{B} + B\overline{C})}}$$

(3 marks)

c) Design a comparator, which compares the magnitude of two 2-bit binary numbers A_1A_0 and B_1B_0, and gives three outputs F_1, F_2, F_3 such that:

i) $F_1 = 1$, if $A_1A_0 > B_1B_0$
ii) $F_2 = 1$, if $A_1A_0 = B_1B_0$
iii) $F_3 = 1$, if $A_1A_0 < B_1B_0$ (**14 marks**)

Question FIVE

a) Perform the following conversions:
   (i) 765_{10} to Octal
   (ii) 10101011011 gray code to Excess 3. **(4 Marks)**

b) Design the simplest sum-of-products logic circuit to implement the function given as $f(A, B, C) = \sum_m(0, 1, 2, 3, 5)$. Use NAND gates **(4 Marks)**

c) A strong room in a bank is to be designed such that three people; the Manager and Accountants can access the room. It is desired that access is possible only if the Manager in Charge and at least one Accountant give authorization. Design the simplest circuit that can be used for this purpose. Use basic gates. **(6 Marks)**

d) Use a truth table to show that $AC + \overline{A}C + A\overline{B}\overline{C} = A\overline{B} + C$ **(6 Marks)**