UGANDA INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
END OF SEMESTER TWO EXAMINATIONS
ACADEMIC YEAR 2023/2024

DEPARTMENT : ICT

SEMESTER : TWO

PROGRAMME : Diploma in Electrical & Electronics Engineering (DEEE)
Diploma in Electronic Communication Engineering (DECE)

YEAR OF STUDY : ONE

COURSE : DIGITAL ELECTRONICS

COURSE CODE : EEE121/EEE1201

DATE : FRIDAY 5TH, JULY 2024

TIME : 9:00A.M – 12:00PM

DURATION : 3 HOURS

INSTRUCTIONS :

(i) This paper contains two Sections A (40 marks) and B (60 marks).

(ii) Attempt ALL questions in Section A and ONLY three questions in Section B.

(iii) All questions in Section B carry equal marks.

(iv) Credit will be given for use of relevant examples and illustrations.

(v) Begin each number in Section B on a new page of the answer sheet.

(vi) DO NOT write on this question paper.

SECTION A [40MARKS]

Attempt ALL the Questions in this Section

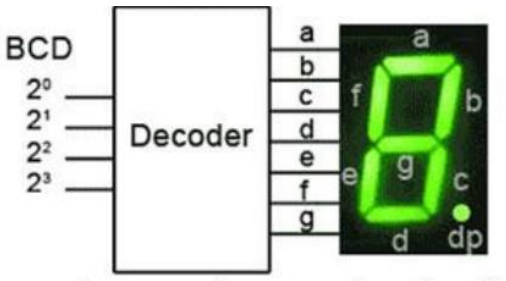
Write the letter of the correct answer in your answer booklet provided. (2 marks @)

1) Identify the logic gate which has two inputs at logic levels:1 and 0, and output at logic 1.
   A. AND gate
   B. OR gate
   C. NOR gate
   D. NOT gate
2) Latches are _____ circuits:
   A. Edge triggered
   B. Pulse triggered
   C. Count triggered
   D. Level triggered
3) A decade counter requires
   A. 4 flip-flops
   B. 3 flip-flops
   C. 10 flip-flops
   D. 2 flip-flops
4) XOR gate
   A. Can be used to know whether two digital inputs are identical
   B. Is a NOT followed by OR
   C. Two OR gates followed by AND
   D. Cannot be used for matching of two inputs
5) An OR gate has 4 inputs. One input is high and the other three are low. The output is …….
   A. Low
   B. High
   C. Alternately high and low
   D. May be high or low depending on relative magnitude of inputs
6) A device which converts BCD to seven segments is called ……..
   A. Encoder
   B. Decoder
   C. Multiplexer
   D. None of these
7) A decade counter skips ……..
   A. binary states 1000 to 1111
   B. binary states 0000 to 0011
   C. binary states 1010 to 1111
   D. binary states 1111 to higher
8) BCD input 1000 is fed to a 7-segment display through a BCD to 7 segment decoder/driver. The segments which will lit up are …….
   A. a, b, d
   B. *a, b, c*
   C. all
   D. *a, b, g, c, d*
9) The expression Y = pM (0, 1, 3, 4) is ……..
   A. POS
   B. SOP
   C. Hybrid
   D. none of these

10) The basic storage element in a digital system is …….
   A. Flip-flop
   B. Counter
   C. Multiplexer
   D. Encoder

Short Answer Questions **(2 marks @)**

11) Convert the binary number 1110.101 to decimal number system.
12) What is the complete expression represented by the minterm Y (A, B, C, D) = ∑ m (1, 3, 5, 7, 8, 9,12)?
13) Convert the decimal number 12.625 to binary number system
14) The 7-segment display below is a common anode and is required to display the digit "3". Answer the questions that follow below:



   (i) Write the BCD code to so that we can display the digit "3".
   (ii) Which of the 7-segments are activated to display "3"?
   (iii) Indicate logic levels of all input segments when displaying "3".
15) Eight D flip-flops are used to build a counter, what is its modulus?
16) Define two's complement and its significance.
17) What is rising edge flip flop?
18) Write the truth table of a JK flip-flop.
19) How can a D flip-flop be made to toggle.

SECTION B: [60 MARKS]

Question 1

a) Consider that you are working with a three-input full adder circuit:
   i) Draw its truth table. **(2 marks)**
   ii) Draw its circuit diagram. **(2 marks)**
   iii) Determine the k-maps of its outputs. **(2 marks)**
   iv) Write the logic equations of its outputs. **(4 marks)**

b) Supposing in a factory, we have four devices (device A, B, C and D) where only one device needs to be selected from the four which are present at the input such that the selected device's signal goes to a centralized processing point. As a student of Nakawa Institute of Technology, you are required to design the system taking into account of the block diagram, truth table and logic circuit. **(10 marks)**

Question 2

In a certain factory process, the output (Soap) is dependent on four materials; materials 1, 2, 3, and 4 (assuming that material 4 is the most significant and material 1 is the list significant). Consider that Soap is produced only when an **even** bit number from the four materials is present at its input. Answer the following questions:

a) Draw a well filled Truth table for the process. **(5 marks)**

b) Give the Boolean un-simplified expression from the table above representing Soap. **(2 marks)**

c) Draw a K-Map for the process using the table above. **(5 marks)**

d) Using a K-Map obtained from part (c) above, determine a simplified expression for Soap. **(3 marks)**

e) Draw a digital logic circuit for Soap. **(5 marks)**

Question 3

Consider the following information:

There are three switches (switch 1 (S1), switch 2 (S2), switch 3 (S3)) which are used to turn on the motor to run the grains conveyor. Each of the following options is used to switch on the motor.

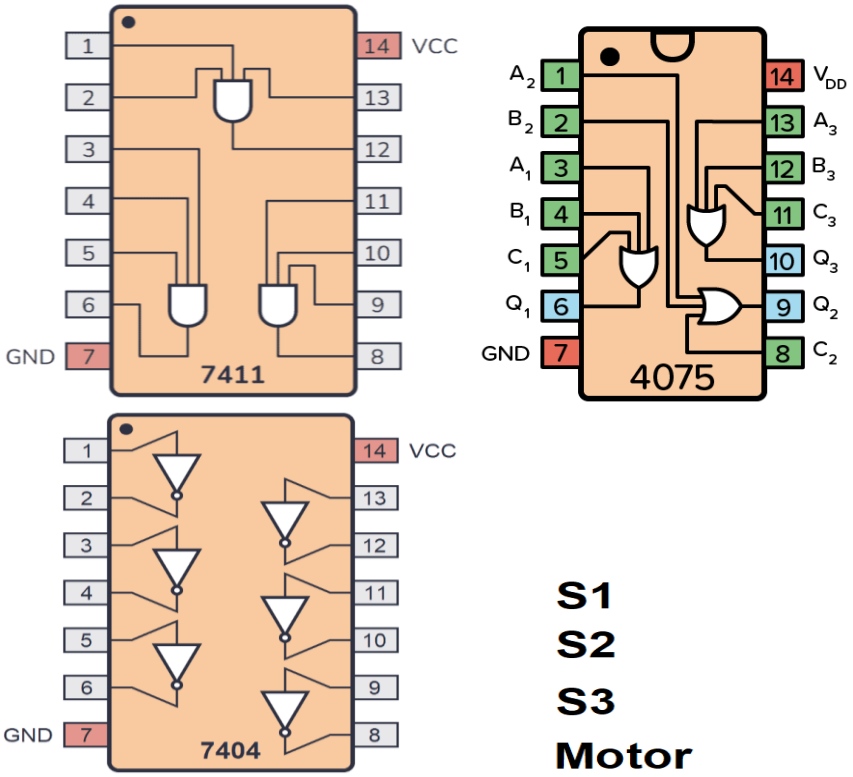
a) Motor runs when switch 2 is off and switch 1 and 3 are on.

b) Motor runs when switch 1 and 2 are off and switch 3 is on.

c) Motor runs when only switch 3 is off and the rest are on.

d) The rest of the switch combinations make the motor to be off.

Use the IC package arrangements below and answer the questions that follow:



i) Write the un-simplified expression for the above information. **(2 marks)**

ii) Draw the wiring diagram using the given IC configurations for part (i) above as you would wire it in the laboratory. **(4 marks)**

iii) Explain the procedure followed in your wiring. **(2 marks)**

iv) Give the truth table for the above information. **(4 marks)**

v) Draw the K-Map from the table above. **(2 marks)**

vi) Determine the simplified expression for the above information. **(2 marks)**
vii) Draw the logic circuit for the simplified expression. **(2 marks)**
viii) Explain how you would measure voltage for the output. **(2 marks)**

Question Six 4

a) Minimize the Boolean equation: $(AB(C+\overline{BD}) + \overline{AB})\,CD$ **(5 marks)**
b) Given the Boolean equation:

$$\overline{A}\,\overline{B}C\overline{D} + \overline{A}B\overline{C}D + \overline{A}BCD + AB\overline{C}D + ABCD$$

(i) Draw the k-map of the equation. **(5 marks)**
(ii) Using the k-map, simplify the equation. **(5 marks)**
(iii) Draw the logic diagram of the simplified equation. **(5 marks)**

Question 5

A beer bottling company wants to minimize the loss of beer due to inaccurate cap-fixing duration. It believes the timing of events can be done by using JK flip flop counters, which is initialized at 255 to countdown and reset at 68.

(i) Indicate the initialization and reset points as hexadecimal number system. **(4 marks)**
(ii) Convert 255 and 68 to binary number system. **(4 marks)**
(iii) Design and draw the logic circuit diagram of the counter. **(12 marks)**