



**UGANDA INSTITUTE OF INFORMATION AND COMMUNICATIONS
TECHNOLOGY
END OF SEMESTER TWO EXAMINATIONS
ACADEMIC YEAR 2025/2026**

DEPARTMENT : ICT & ENGINEERING

YEAR OF STUDY :I

SEMESTER : II

**PROGRAMME : Diploma in Electronic & Communication Engineering [DECE]
Diploma in Electrical & Electronic Engineering [DEE]**

COURSE : Digital Electronics

COURSE CODE : EEE121

DATE : 27th June 2026

TIME : 9:00 – 12 p.m.

DURATION : 3 Hours

LOCATION : TENT A & B

INSTRUCTIONS:

- (a) This paper consists of Section A and Section B**
- (b) Section A carry 40 marks and is compulsory**
- (c) Attempt any THREE questions from section B**
- (d) Any question number in section B carry equal marks**

SECTION A (40 marks)

Choose and write the letter of the most correct Answer

Question One

(2marks@)

- 1) In Production Counter Design, a digital counter must add incoming pulses to an accumulated count. Which circuit performs binary addition?
A. Decoder
B. Adder
C. Encoder
D. Register

- 2) 1's complement for the binary code 11011001 is _____:
A. 10011011
B. 00100110
C. 11011001+1
D. 011011001

- 3) In Factory Security System, the alarm should activate when exactly one of two doors is open. Which gate performs this operation?
A. XOR
B. OR
C. AND
D. NAND

- 4) In Factory Automation Upgrade, an engineer requires a logic family with very low power consumption. Which family is most suitable?
A. RTL
B. DTL
C. CMOS
D. ECL

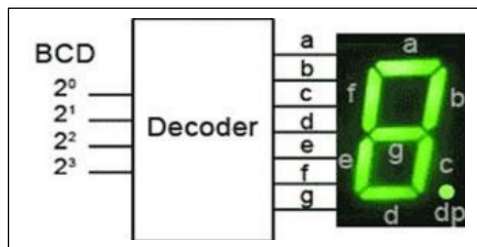
- 5) In relation to Factory Product Routing, a single control signal must be directed to one of four robotic arms. Which device is used?
A. Multiplexer
B. Encoder
C. Demultiplexer
D. Adder

- 6) Simplify the Boolean equation: $(\bar{A} B + A \bar{B})$
A. $AB + AB$
B. $A \oplus B$
C. $AB \oplus AB$

- D. $A'B+AB'$
- 7) An 8-input memory decoder can contain a maximum of _____ address lines.
- 255
 - 256
 - 8x8
 - 128
- 8) RAM memory whose content is not lost if power is taken off is called _____.
 - SRAM
 - DRAM
 - NVRAM
 - ROW RAM
- 9) An emergency button is pressed and the machine remains OFF until manually reset. Which device stores this state?
 - Decoder
 - Flip-Flop
 - Encoder
 - Multiplexer
- 10) In Industrial Sensor Communication, an Even parity is used. Data bits are 1011010. Parity bit should be:
 - 0
 - 1
 - 2
 - Depends on voltage

Provide Short Brief Answers to questions “10 to 20”

- Convert the decimal number: 12.625 to binary (2marks)
- what is the difference between the TTL and CMOS (2marks)
- The 7-Segment decoder provided is a Common Anode.



- To display the digit “5” what BCD code should be set? (1marks)
 - To display the digit “8” what BCD code should be set? (1marks)
 - What is the voltage at the active segments? (1marks)
 - What digit is displayed if “a,b,c,d,e,f,g” are active ? (1marks)
- What is the main advantage of Master-Slave flip-flop? (2marks)
 - Write the Boolean equation for a multiplexer with 8 data sources. (2 marks)

- 6) State De Morgan's theorems. (2marks)
- 7) Use logic diagrams to represent De Morgan's theorems. (2marks)
- 8) Convert BCD code 0111 to Gray code (2 marks)
- 9) Draw the truth table of a D-flip flop. (2 marks)

SECTION B (60 marks)-ATTEMPT ANY 3

Question Two (20 marks):

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

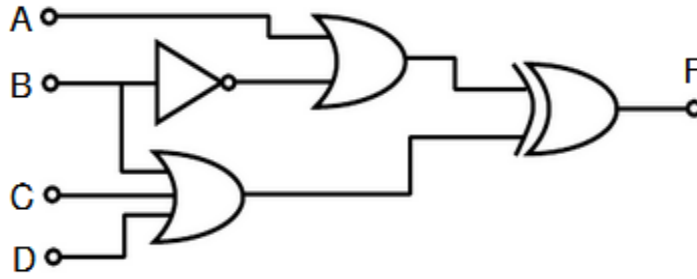
$$\overline{A}\overline{B}C\overline{D} + \overline{A}B\overline{C}\overline{D} + \overline{A}BCD + A\overline{B}C\overline{D} + ABCD$$
 (i) Draw the k-map. (5 marks)
- (ii) Using the k-map, simplify the equation. (5 marks)
- Draw the logic diagram of the simplified equation. (5 marks)

QUESTION Three (20 marks):

- a) A beverage factory has four production lines. Each line has a temperature sensor:
- I_0 = Temperature of Line 1
 - I_1 = Temperature of Line 2
 - I_2 = Temperature of Line 3
 - I_3 = Temperature of Line 4
- To reduce wiring costs, only one sensor is sent to the control room at a time using a 4:1 Multiplexer. The selected line is determined by two control signals S_1 and S_0 .
- i) Draw the block diagram of the Multiplexing device used. (3 marks)
- ii) Construct the truth table. (3 marks)
- iii) Determine the output when $S_1=1$ and $S_0=0$. (2 marks)
- iv) State one advantage of using a multiplexer. (2 marks)
- b) A PLC device receives sensor data 1011 and temporarily stores it in a 4-bit register.
- i) Define a register. (2 marks)
- ii) State the contents after loading. (2 marks)
- iii) How many flip-flops are required? (2 marks)
- iv) Draw the register block diagram. (4 marks)

QUESTION Four (20 marks):

A logic gate circuit with four inputs A, B, C and D and output F is shown in figure below.



- i) Write the un-simplified Boolean expression for the function F. (2 marks)
- ii) Give a truth table for the function F. (4 marks)
- iii) From the truth table, write out a 'sum of products' expression for the function F. (2 marks)
- iv) Plot the sum of products function F onto a Karnaugh Map. (4 marks)
- v) Directly from the Karnaugh map, write out the minimized function for F. (5 mark)
- vi) Draw the logic circuit for the simplified expression. (3 marks)

Question Five (20 marks):

A beverage factory pumps water from a storage reservoir into a treatment plant. Water should only be pumped or drained when need arises. The supply and drain pumps operate differently.

- Either the supply pump (S) or drain pump (D) is on, water has to flow in and out of the reservoir.
- Water (W) being the third variable (LSB) and Supply pump (S) being the MSB.
- Each pump has a motor attached to it.

Considering that we need such a system to be implemented:

- a) Construct the truth table for the above factory. (5 marks)
- b) From the true table, write the un-simplified Boolean expression representing the factory operation. (2 marks)
- c) From the true table, represent its output on k-map. (5 marks)
- d) From the k-map, determine the simplified expression. (3 marks)
- e) Draw the logic circuit for the factory operation. (5 marks)

Question Six (20 marks):

- a) A timer, using JK flip flop circuits is required to record an event related to electronic warfare radar antenna scan system. The event is initialized (start of the count) at 15 then counts downwards till 9, then resets.
 - (i) Draw the truth table of the countdown, clearly indicating the reset state. (4 marks)
 - (ii) Draw the logic circuit diagram of the binary counter. (8 marks)
- b) State two applications of binary counters and draw clear circuit diagram(s) illustrating how 750KHz can be obtained from a 12MHz crystal oscillator. (8 marks)

END OF SECTION