1.a) Component of a Computer System (Similar to the Brain)

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1.b) Types of Memory: Volatile vs. Non-Volatile

Volatile Memory (e.g., RAM – Random Access Memory)

- **Functionality:** Acts as temporary working storage for active programs and data.
- **Speed:** Extremely fast, allowing quick access for the CPU.
- **Data Retention:** Only retains data while the computer is powered on. Once power is lost (e.g., shutdown), all stored data is erased.
- **Usage:** Essential for running operating systems, applications, and multitasking.

Non-Volatile Memory (e.g., HDD, SSD, ROM – Read-Only Memory)

- **Functionality:** Stores data permanently, even without power.
- **Speed:** Slower than volatile memory (though SSDs are faster than HDDs).
- **Data Retention:** Retains data indefinitely unless manually deleted or corrupted.
- **Usage:** Used for long-term storage (e.g., files, operating systems, firmware).

Key Differences Summary:

Feature	Volatile Memory (RAM)	Non-Volatile Memory (HDD/SSD)
Data Retention	Temporary (lost on power-off)	Permanent (retains data)
Speed	Very fast	Slower (SSD > HDD)
Purpose	Active processing	Long-term storage
Examples	DRAM, SRAM	HDD, SSD, USB, ROM

Volatile memory is crucial for real-time operations, while non-volatile memory ensures data persistence.

1.c) Number System Conversions

l) Octal (73124.14) to Decimal

Break into integer & fractional parts:

• **Integer part $(73124)_8$:**

$7 \times 8^4 + 3 \times 8^3 + 1 \times 8^2 + 2 \times 8^1 + 4 \times 8^0$

= 28672 + 1536 + 64 + 16 + 4 = 30292

Fractional part $(0.14)_8$:

$1 \times 8^{-1} + 4 \times 8^{-2} = 0.125 + 0.0625 = 0.1875$

• **Result: 30292.187510**

II) Decimal (3005) to Hexadecimal

- Divide by 16 repeatedly:
- 3005 / 16 = 187 → Remainder **13 (D)**
- 187 / 16 = 11 → Remainder **11 (B)**
- 11 / 16 = O → Remainder **11 (B)**

- **Result: BBD_{16}**

Ill) Hexadecimal (A9B31F) to Octal

1. Convert hex to binary (each digit = 4 bits):

   A = 1010, 9 + 1001, B = 1011, 3 = 0011, 1 = 0001, F = 1111

   →$101010011011001100011111_2$

2. Group binary into sets of 3 (from right):

   101 010 011 011 001 100 011 111

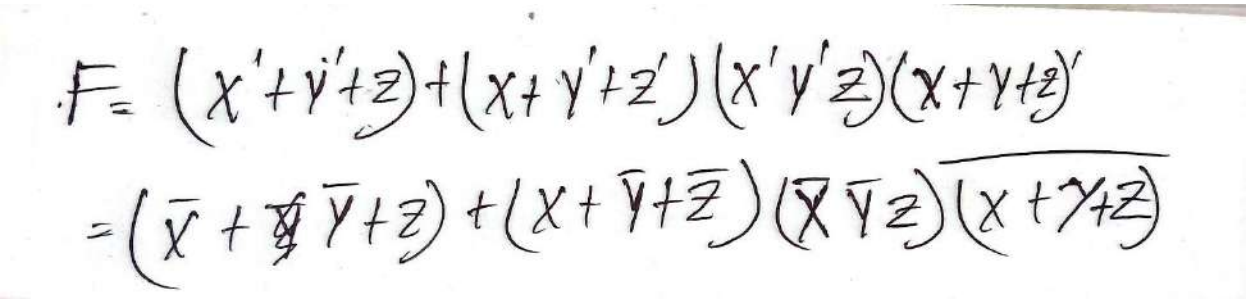
3. Convert each group to octal:

   5 2 3 3 1 4 3 7

• **Result: 52331437_8**

2.a) Illustration of a logic circuit.

F=(X'+Y'+Z) + (X+Y'+Z') (X'Y'Z) (X+Y+Z)'



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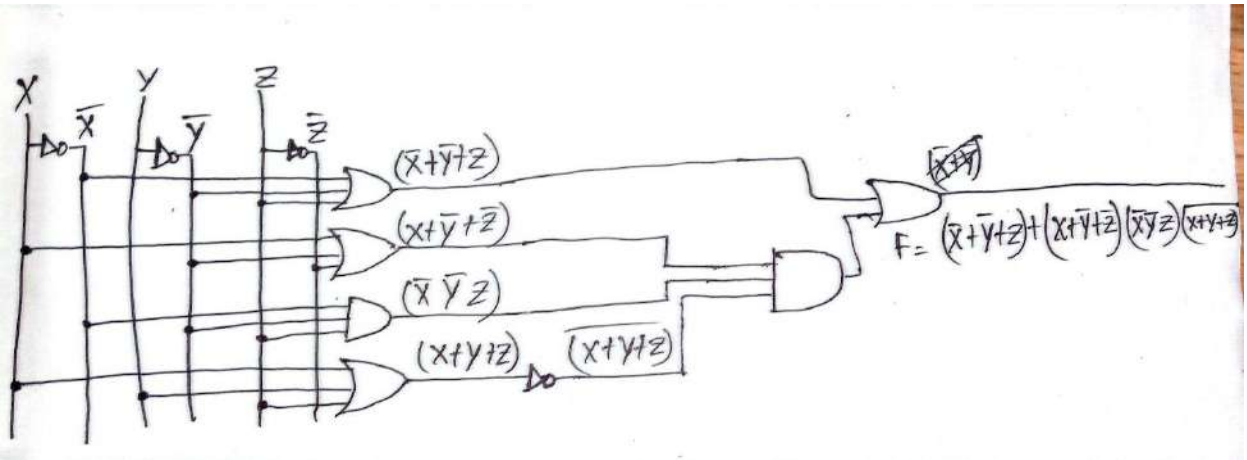
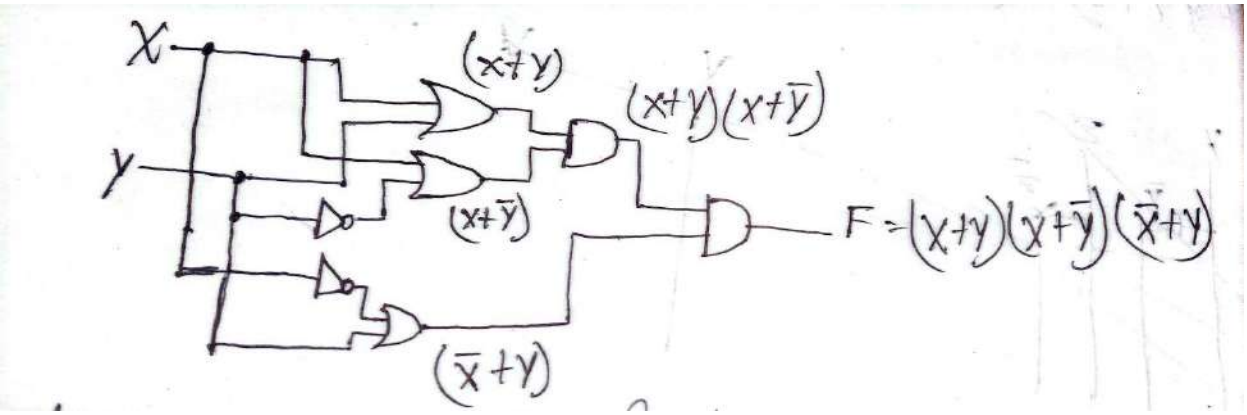


2.b) Extracting the Boolean equation from the circuit, simplifying it, then proving it using a truth table.

Let's take "X" & "Y" as the variables & complete the circuit.



So, the Boolean equation for the given circuit: ***F*=(*X*+*Y*) (*X*+*Y*') (*X*'+*Y*)**

Simplification of the Boolean Expression

The given Boolean expression is:

F=(X+Y) (X+Y') (X'+Y)

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(X+Y) (X+Y') = X + (Y·Y')

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Step 2: Apply the Distributive Law Again

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Final Simplified Expression

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Proof Using a Truth Table

We will compare the original expression F=(X+Y)(X+Y')(X'+Y) with the simplified form F=XY.

X	Y	X'	Y'	X+Y	X+Y'	X'+Y	Original F	Simplified F (XY)
0	0	1	1	0	1	1	0 (0·1·1=0)	0
0	1	1	0	1	0	1	0 (1·0·1=0)	0
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Conclusion

- The original expression and the simplified expression (XY) produce the same output in all cases.
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What it is: The main circuit board connecting all components (CPU, RAM, GPU, storage, etc.).

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1. **CPU Hub** – Holds the processor and regulates its power.
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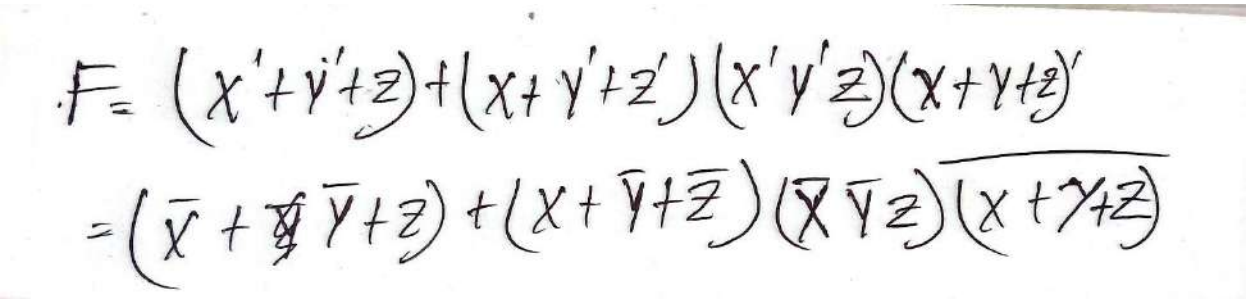

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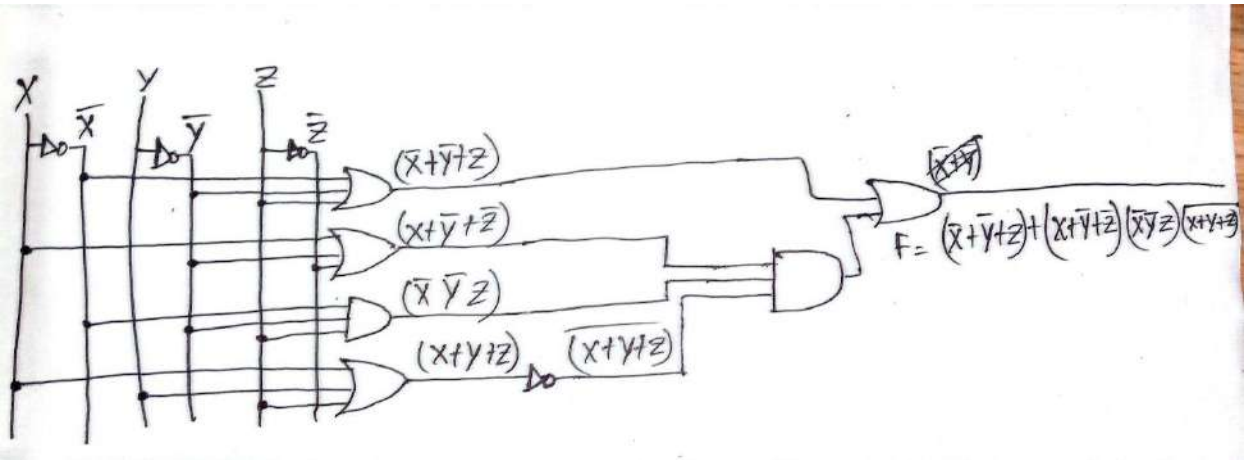

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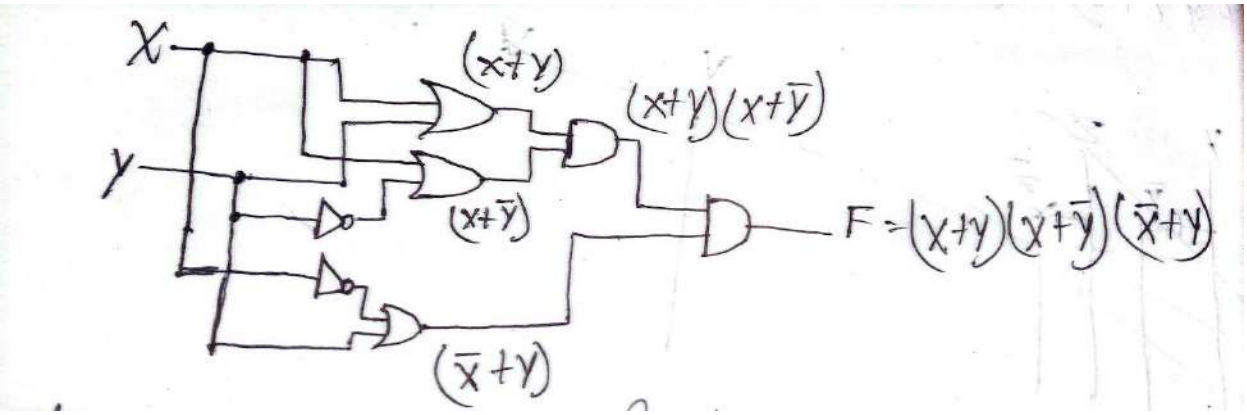

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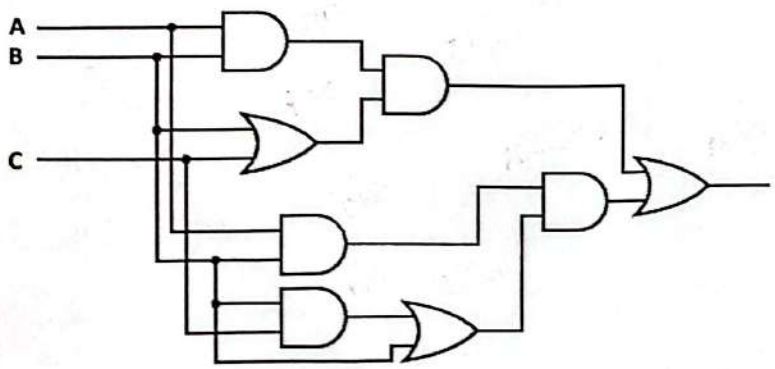
Daffodil International University

Department of Software Engineering
Faculty of Science & Information Technology
Midterm Examination, Spring 2025
Course Code: SE 111; Course Title: Computer Fundamentals
Sections & Teachers: NJM(A,B), MRD(C,D), SI(E,I,J), MKS(F), TAK(G,H), KR(K,M), KF(L)

Time: 1 Hour 30 Mins **Marks: 25**

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1.	*a)*	TechNova a small company recently installed operating system for their office computers. One of the characteristics of that operating system is, it is UNIX operating system with C programming. UNIX is a multi-user and multitasking operating system designed for efficiency and flexibility. The main reason to install this type of operating system is, it supports multiple users at once and provides a command-line interface **Explain** the generation of computer mentioned in the above scenario with its other software technologies.	[Marks-3]	CLO-1 *C2*
	b)	A computer runs a program instantly accessing data from a type of storage for quick processing. Later, it saves files sequentially for long-term use in another type of storage. When needed again the system searches in order to retrieve the stored data. This ensures fast execution for active tasks while keeping information accessible for future use. **Compare** the above-mentioned memories with example.	[Marks-3]	
	c)	i) **Convert** 456_9 to its Base 4 equivalent Number. ii) **Convert** 1111110.1001_2 to its Base 10 equivalent Number. iii) **Convert** $D16_{16}$ to its Base 8 equivalent Number.	[Marks-9]	
2.	*a)*	**Illustrate** a logic circuit for the following Boolean expression. **F= AB'(AC+BC)'+A'C+A'B'(BC')+AC+B'C**	[Marks-3]	CLO-2 *C4*
	b)	**Identify** the final output for the below logic circuit diagram also simplify the output result and prove your simplification using truth table. 	[Marks-7]	

1.a) Generation of Computer & Software Technologies in the Scenario

The scenario describes a **UNIX-based operating system**, which aligns with **Third Generation (1965–1980) and Fourth Generation (1980–present) computers**.

Key Features:

- **Multi-User & Multitasking:** UNIX supports multiple users running programs simultaneously (Third Gen innovation).
- **Command-Line Interface (CLI):** Early UNIX relied on CLI, though modern versions (e.g., Linux) also offer GUIs.
- **C Programming:** Developed alongside UNIX (1972), C became the backbone of OS development (Fourth Gen).

Other Software Technologies of This Era:

- **Database Systems:** Oracle (1977), SQL.
- **Networking:** TCP/IP (1980s), enabling internet connectivity.
- **Open-Source:** Linux (1991), a UNIX-like OS, expanded flexibility.

1.b) Comparison of Memory Types

1. Fast, Temporary Storage (e.g., RAM)

- **Function:** Holds active programs/data for instant CPU access.
- **Example:** DDR4 RAM (8GB–32GB in modern PCs).
- **Characteristics:**
    - Volatile (loses data on power-off).
    - Nanosecond-speed access.

2. Slow, Permanent Storage (e.g., HDD)

- **Function:** Stores files sequentially for long-term use.
- **Example:** 1TB HDD (spinning disk).
- **Characteristics:**
    - Non-volatile (retains data).
    - Millisecond-speed access; slower due to mechanical parts.

Key Difference:

Feature	RAM	HDD
Speed	Extremely fast	Slow
Persistence	Volatile	Non-volatile
Cost	Expensive/GB	Cheap/GB
Use Case	Active tasks	Long-term storage

1.c) Number System Conversions

i) 456_9 → Base 4

1. **Convert 456_9 to Decimal:**
   $4\times9^2+5\times9^1+6\times9^0=324+45+6=375_{10}$
2. **Convert 375_{10} to Base 4:**
   - 375÷4=93 → Remainder **3**
   - 93÷4=23 → Remainder **1**
   - 23÷4=5 → Remainder **3**
   - 5÷4=1 → Remainder **1**
   - 1÷4=0 → Remainder **1**
   - **Result:** 11313_4.

ii) 1111110.1001_2 → Decimal

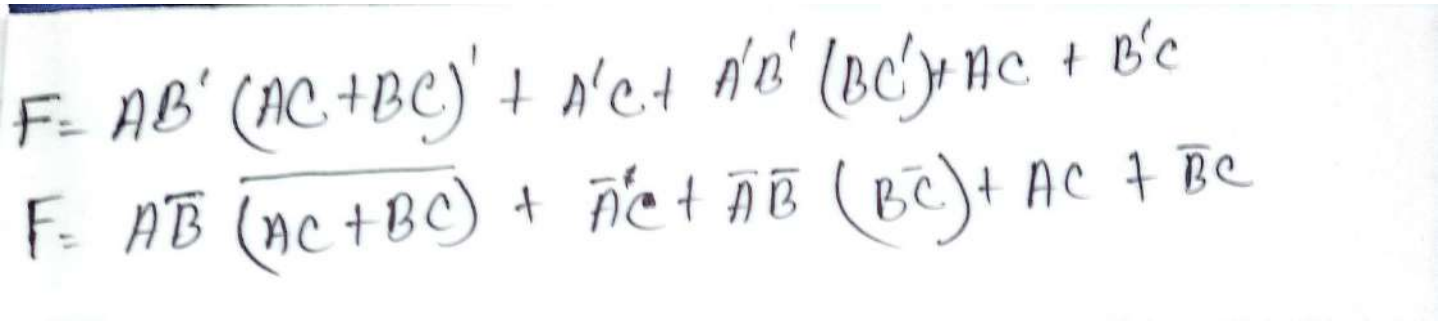
- **Integer Part (1111110_2):**
  $1\times2^6+1\times2^5+1\times2^4+1\times2^3+1\times2^2+1\times2^1+0\times2^0=\ 64+32+16+8+4+2+0=\ 126_{10}$
- **Fractional Part (0.1001_2):**
  $1\times2^{-1}+0\times2^{-2}+0\times2^{-3}+1\times2^{-4}=\ 0.5+0.0625=\ 0.5625_{10}$.
- **Result:** 126.562510126.562510.

iii) $D16_{16}$ → Octal

1. **Convert $D16_{16}$ to Binary:**
   D=1101, 1=0001, 6=0110 → **110100010110_2**.

2. **Group into 3-bit octal units:**
   110 100 010 110 → 6 4 2 6.
3. **Result:** 6426_8.

2.a) Logic Circuit for F = AB' (AC + BC)' + A'C + A'B' (BC') + AC + B'C.



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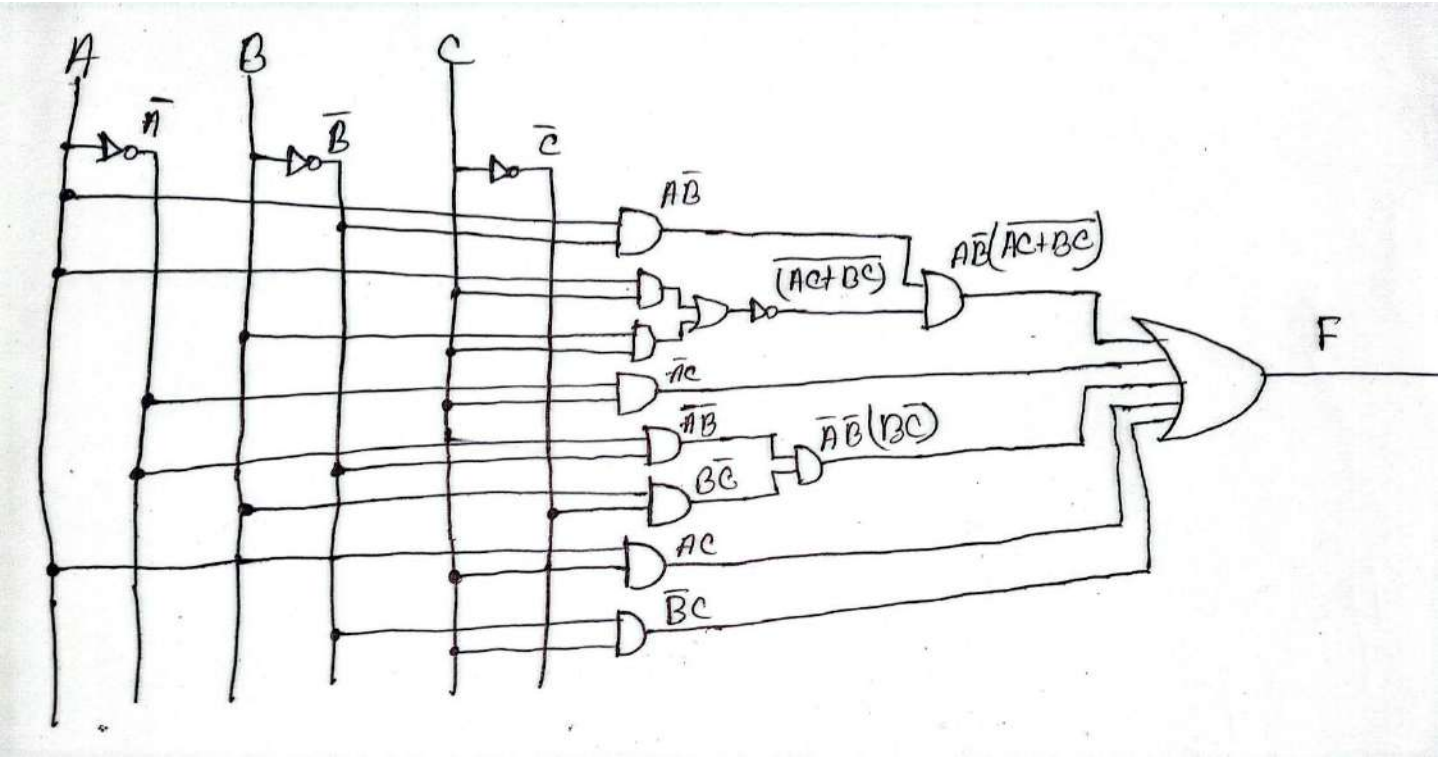

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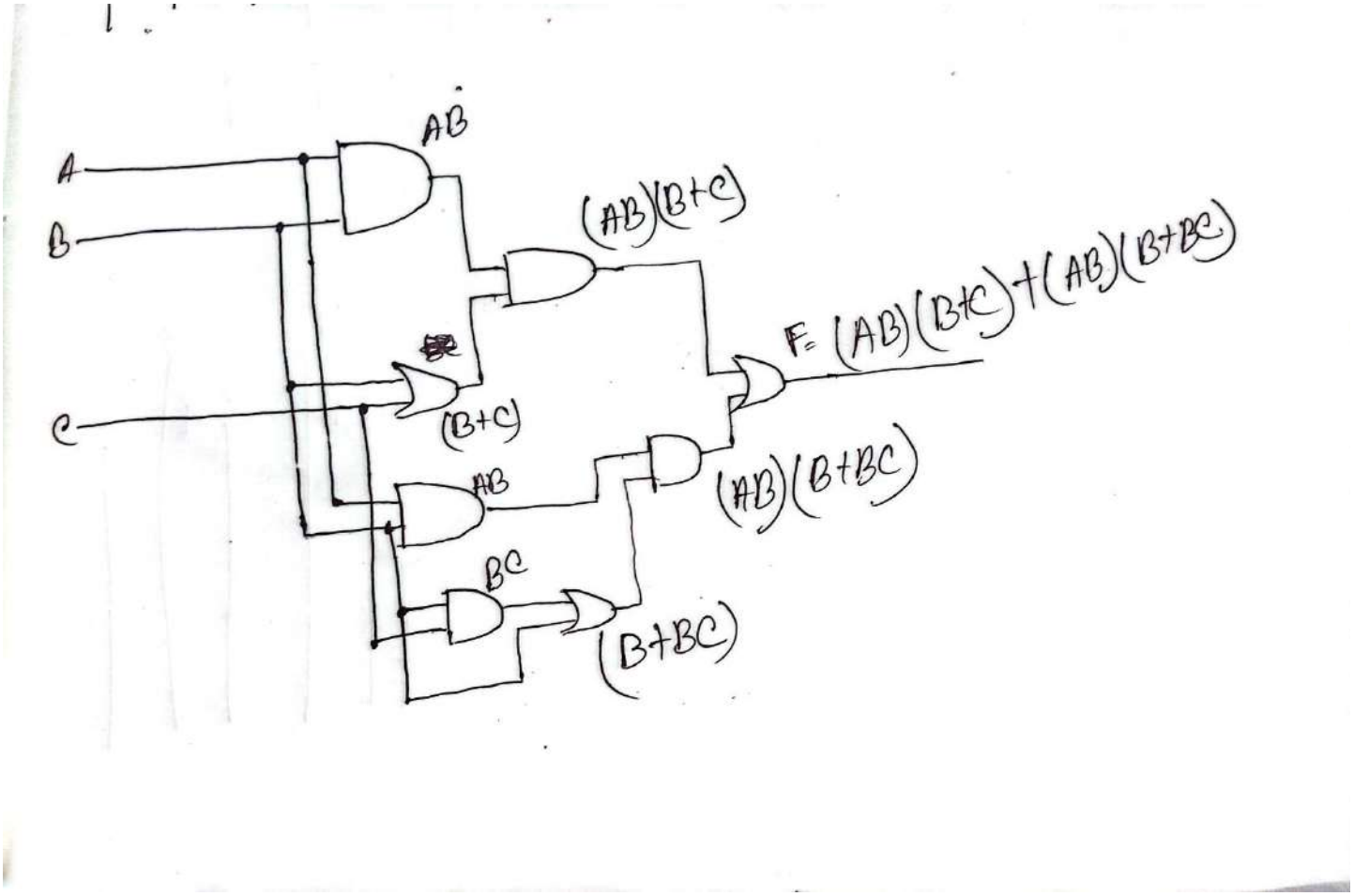

As the circuit follows, the Boolean equation is:

F = (AB) (B+C) + (AB) (B+BC)

Simplification of the Boolean Expression

The given Boolean expression is:

F = (AB) (B+C) + (AB) (B+BC)

Step 1: Factor Out (AB)

F = AB · [(B+C) + (B+BC)]

Step 2: Simplify Inside the Brackets

1. **First term: B+C**
2. **Second term: B+BC**
    - Apply the Absorption Law (B+BC=B):

      B + BC = B(1+C) = B

3. Combine terms:

   (B+C) + B = B + C

Step 3: Final Simplification

F = AB · (B+C)

- **Distribute AB: F = ABB+ABC**
- **Simplify ABB = AB (since BB = B): F = AB + ABC**
- **Apply the Absorption Law again: F = AB**

Step 4: Final Simplified Expression

F = AB

Proof Using a Truth Table

We compare the original expression F=(AB)(B+C)+(AB)(B+BC)*F*=(*AB*)(*B*+*C*)+(*AB*)(*B*+*BC*) with the simplified form F=AB*F*=*AB*.

A	B	C	AB	B+C	B+BC	Original F	Simplified F (AB)
0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0
0	1	0	0	1	1	0	0
0	1	1	0	1	1	0	0
1	0	0	0	0	0	0	0
1	0	1	0	1	0	0	0
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