The University of Azad Jammu & Kashmir, Muzaffarabad

Computer Architecture & Logic Design

Lab 05: HALF ADDER IMPLEMENTATION

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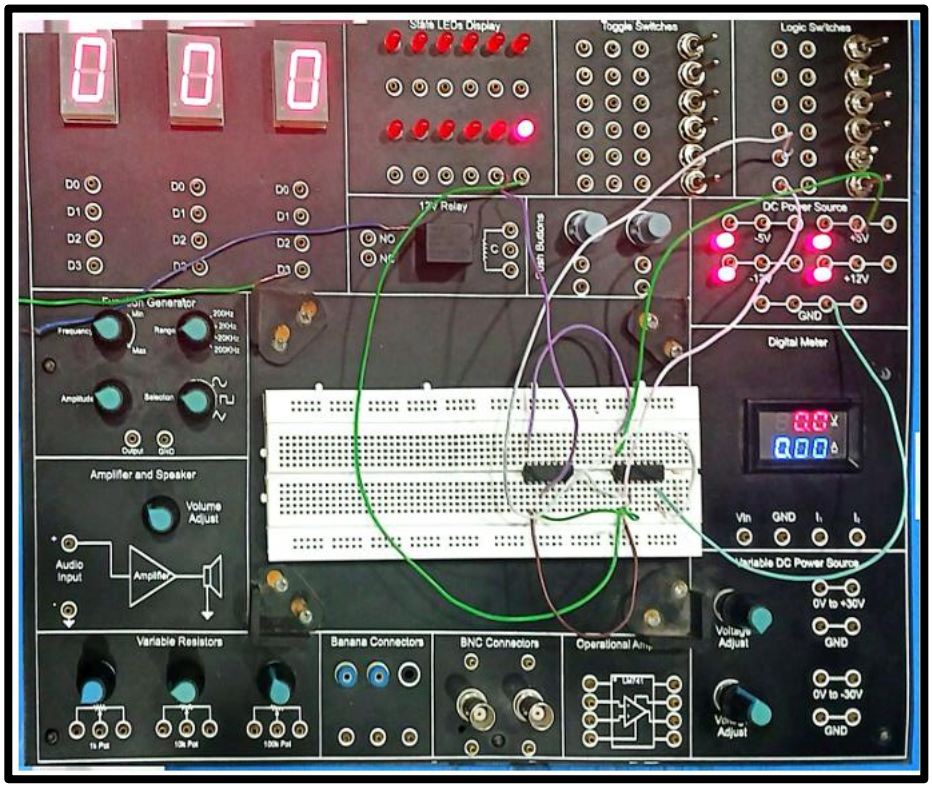
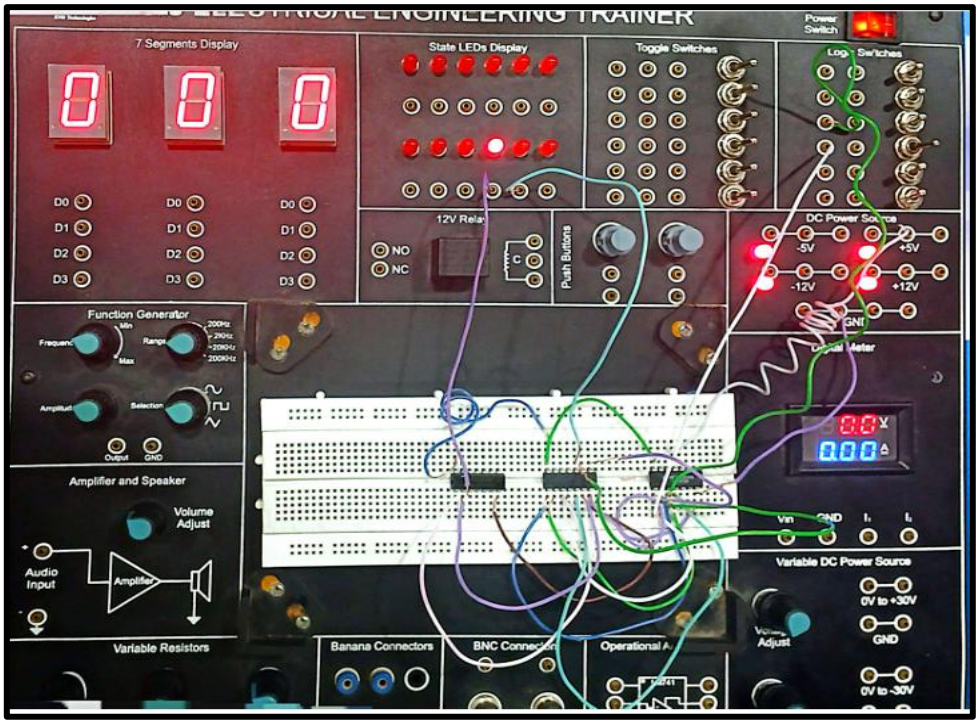
Department of Software Engineering

Practical Implementation on Trainer (Using ICs)

1. **Place the ICs on the breadboard**:
    - IC 7486 (XOR gate)
    - IC 7408 (AND gate)



2. **Provide power connections**:
    - Connect **Vcc (pin 14)** and **GND (pin 7)** of both ICs.
3. **Connect input lines**:
    - Use two push-button switches or toggle switches for Input A and Input B.
    - Connect these inputs to corresponding pins of both ICs.
4. **Connect output lines**:
    - XOR output pin → LED for `Sum`
    - AND output pin → LED for `Carry`
5. **Use appropriate resistors** (typically 330Ω–1kΩ) in series with LEDs to prevent overcurrent.



6. **Power the board** and toggle switches to test combinations:
    - 0 + 0 → Sum = 0, Carry = 0
    - 0 + 1 → Sum = 1, Carry = 0
    - 1 + 0 → Sum = 1, Carry = 0
    - 1 + 1 → Sum = 0, Carry = 1

2. Implementation in Electronics Workbench (EWB)

Part A: Half Adder using Logic Gates

Components:

- 2x SPST Switches
- 1x XOR Gate
- 1x AND Gate
- 2x LEDs
- Resistors (220Ω)
- Power Source (+5V)

Steps:

1. Launch **EWB** and start a new project.
2. Drag and place two **SPST switches** labeled A and B.
3. Insert one **XOR gate** for **Sum output**.
4. Insert one **AND gate** for **Carry output**.
5. Connect:
    - Inputs A and B to both XOR and AND gates.
    - Output of XOR to **LED1** (Sum)
    - Output of AND to **LED2** (Carry)
6. Connect a **220Ω resistor** in series with each LED.
7. Attach LEDs to **ground** to complete the path.
8. Power the circuit with a **+5V** source.
9. Test all 4 input combinations (00, 01, 10, 11) using switches and verify the output with the truth table.

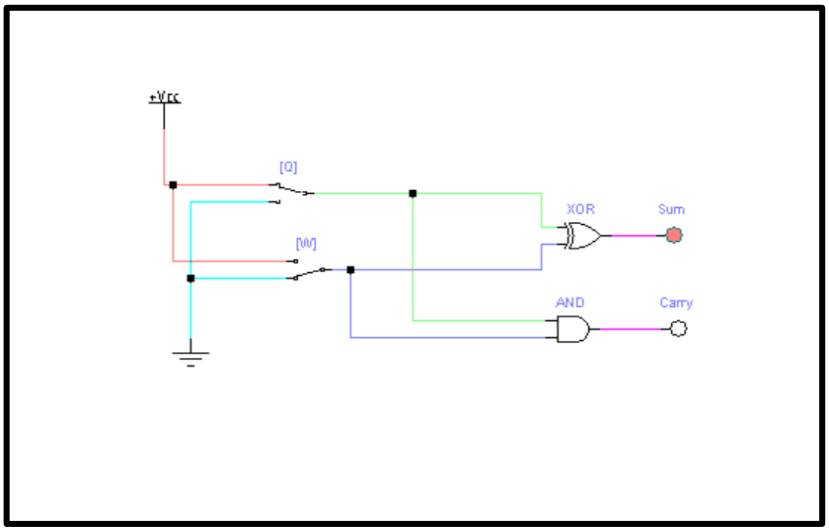


Figure 1: Gate Circuit of HALF ADDER

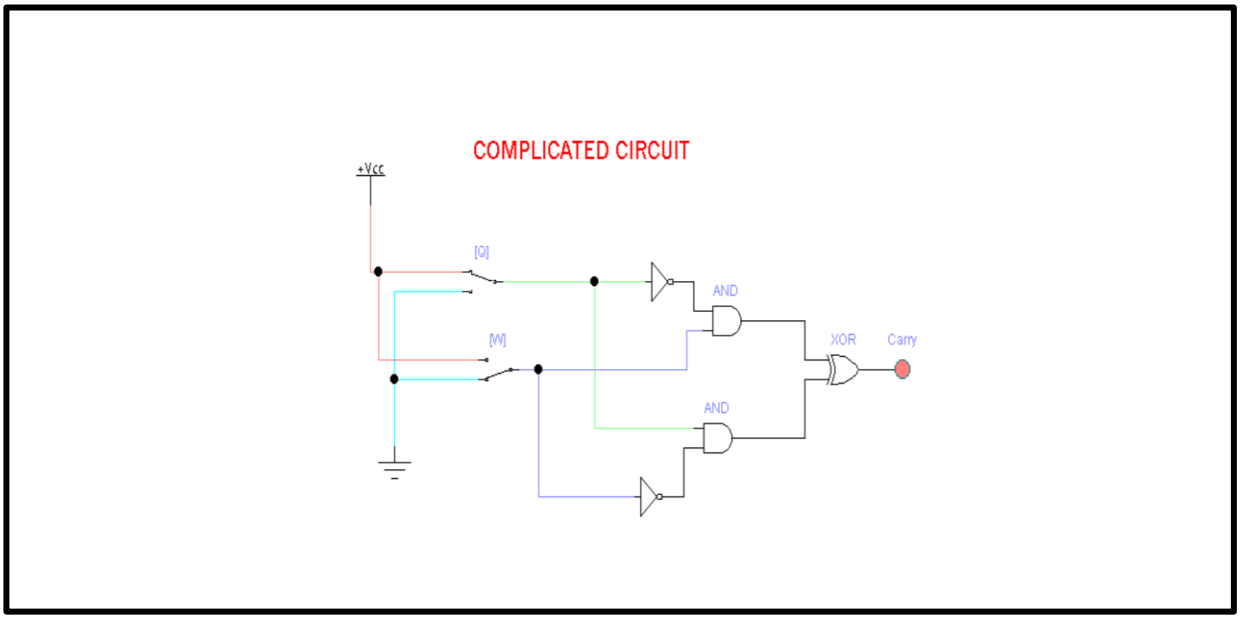


Figure 2: Complicated Circuit Diagram of Half Adder

Part B: Half Adder using Digital ICs

ICs Used:

- **IC 7486** → XOR Gate (for Sum)
- **IC 7408** → AND Gate (for Carry)

Components:

- IC 7486 (Quad XOR gate)
- IC 7408 (Quad AND gate)
- 2x SPST Switches
- 2x LEDs
- Resistors (220Ω)
- Breadboard (or simulated in EWB)
- Power Supply (+5V and GND)

Steps:

1. Place **IC 7486** and **IC 7408** in your circuit.
2. Connect **Pin 14** of both ICs to **+5V**, and **Pin 7** to **GND**.
3. Use:
    - **IC 7486 XOR gate 1** (pins 1, 2 → input; pin 3 → Sum output)
    - **IC 7408 AND gate 1** (pins 1, 2 → input; pin 3 → Carry output)
4. Inputs A and B are connected to both XOR and AND inputs using SPST switches.
5. Outputs (Pin 3 from each IC) go to **LEDs** with 220Ω resistors.
6. Complete the LED connections to **ground**.

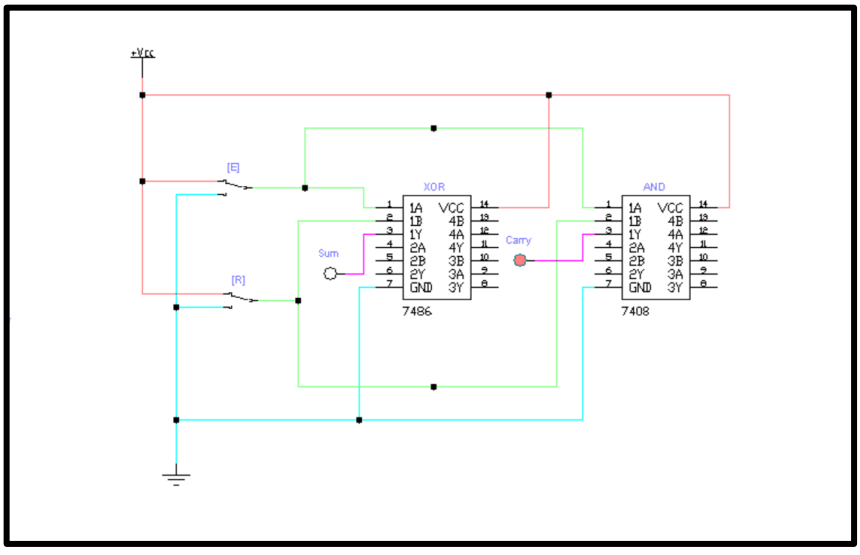


Figure 3: IC Circuit Implementation of HALF ADDER

7. Test the inputs by toggling switches and compare output LEDs with the **truth table**.

Truth Table of Half Adder

A	B	Sum (A⊕B)	Carry (A·B)
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1