

**CLO # 1: Understanding and implementation of the adder/subtractor/multiplier circuits for real-world application.**

Q1. Design Full Adder using decoders and use minimum number of gates. [10 marks]

**CLO # 2: Identify the use case of binary comparators in real-world systems and applications.**

Q2. Design and construct an 1 x 16 DEMUX with 1 x <sup>Mux</sup>4 DEMUX in Logic Works. Draw the truth table of 1 x 16 DEMUX. [10 marks]

**CLO # 3: Understand how computers store data using latches and flip flops, how counters operate with respect to incrementing and decrementing values.**

Q3. A digital lock opens only when a 4-bit input code matches the pre-set 4-bit access code stored in memory. Question: Design a digital circuit using a comparator that will unlock the system only when the input code is equal to the stored code. [10 marks]

Use EN → Enable (1 = Compare, 0 = No output)

- Based on the comparison:
  - (A > B) Lock.
  - (A < B) Lock.
  - A = B) OPEN.

- A3-A2-A1-A0 → 4-bit
- B3-B2-B1-B0 → 4-bit

**CLO # 3:** Understand how computers store data using latches and flip flops, how counters operate with respect to incrementing and decrementing values.

[20 Marks]

**Q4:** Design a circuit using **D flip-flops** to generate a **binary counting sequence**. The sequence should represent decimal numbers from **0 to 7**, progressing in binary as follows:

This sequence should repeat after every **eight clock pulses**, cycling back to 000. The design must ensure the flip-flops count in proper binary order from 0 to 7, then restart the sequence automatically.

**Hint:**

Use three D flip-flops to create a 3-bit binary counter. Each flip-flop output corresponds to one bit of the binary number.

**Binary Sample Output and Decimal Sample Output:**

