

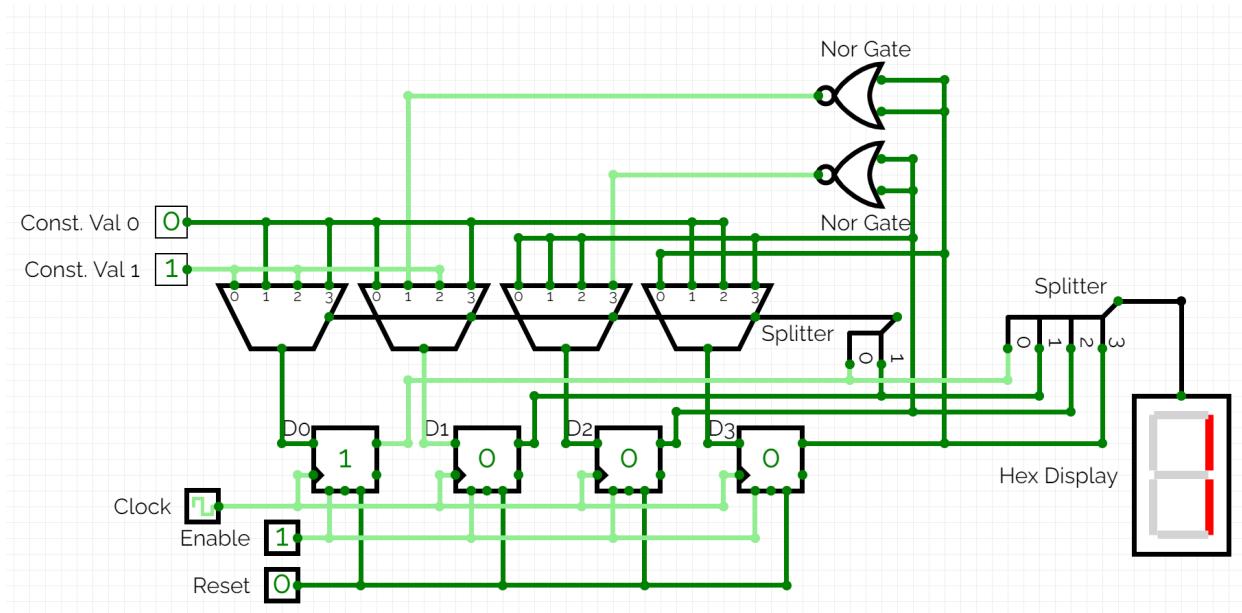
AIM 1 : Design a synchronous decade UP counter. Realize inputs of D-flip flops with 4-input multiplexers, using Q1Q0 as the select inputs. Realize the Data inputs of the multiplexers with NOR gates. (Use Hex- display for output)

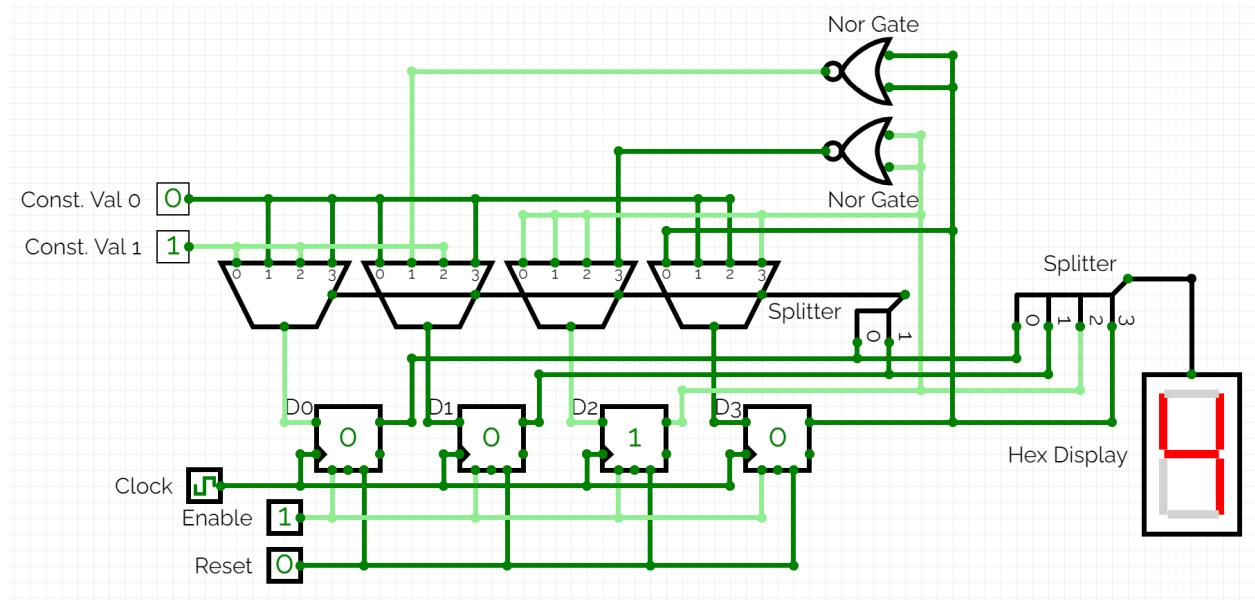
Components Used : 4 D flip-flops , 4 4x1 Multiplexers , 1 Clock generator , 2 input , 2 constant value (0,1), 2 Nor gates , 2 splitters , 1 Hex Display

Youtube Video Link:

<https://youtu.be/9Y-0AXn-KEw>

Screenshots :



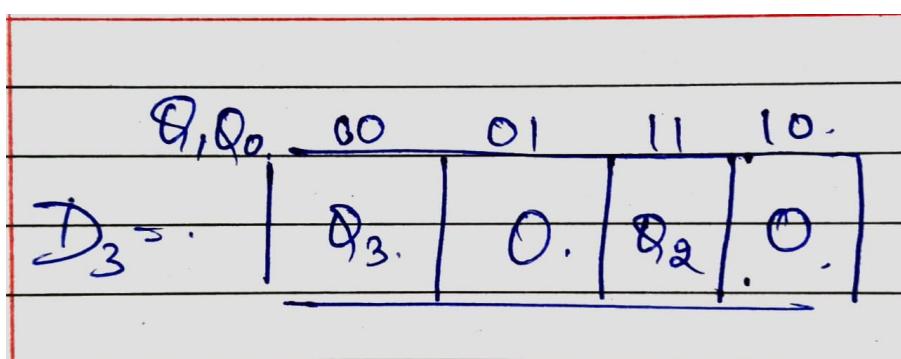
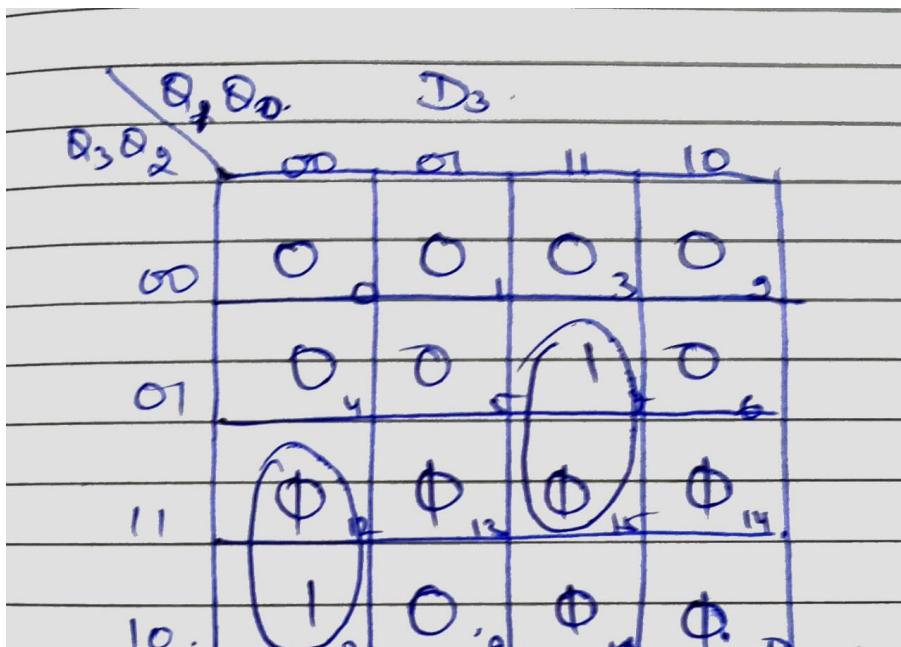


Truth Table :

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 1 | x | x | x | x | x | x | x | x | x |
| 1 | 1 | 0 | 0 | x | x | x | x | x | x | x | x | x |
| 1 | 1 | 0 | 1 | x | x | x | x | x | x | x | x | x |
| 1 | 1 | 1 | 0 | x | x | x | x | x | x | x | x | x |
| 1 | 1 | 1 | 1 | x | x | x | x | x | x | x | x | x |

Kmaps :

D3 :



D2 :

D_2 .

| $\cancel{Q_3 Q_0}$ | 00 | 01 | 11 | 10 |
|--------------------|-------------|-------------|-------------|-------------|
| 00 | 0,0 | 0,1 | \cup_3 | Q_2 |
| 01 | 0,1 | 1,1 | 0 | 1,0 |
| 11 | Φ_{12} | Φ_{13} | Φ_{15} | Φ_{14} |
| 10 | 0,8 | 0,9 | Φ_{11} | Φ_{10} |

$Q_1 Q_0$

| $Q_1 Q_0$ | 00 | 01 | 11 | 10 |
|-----------|-------|-------|-------------|-------|
| D_2 | Q_2 | Q_2 | \bar{Q}_2 | Q_2 |

D1 :

| D ₁ | | | | |
|----------------|-----------------|-----------------|-----------------|-----------------|
| 00 | 01 | 02 | 03 | 04 |
| 00 | 0. | 1 | 0 ₃ | 1 |
| 01 | 0 ₄ | 1 | 0 ₇ | 1 ₆ |
| 02 | Φ ₁₂ | Φ ₁₃ | Φ ₁₅ | Φ ₁₄ |
| 03 | 0 ₈ | 0 ₁ | Φ ₁₁ | Φ ₁₀ |

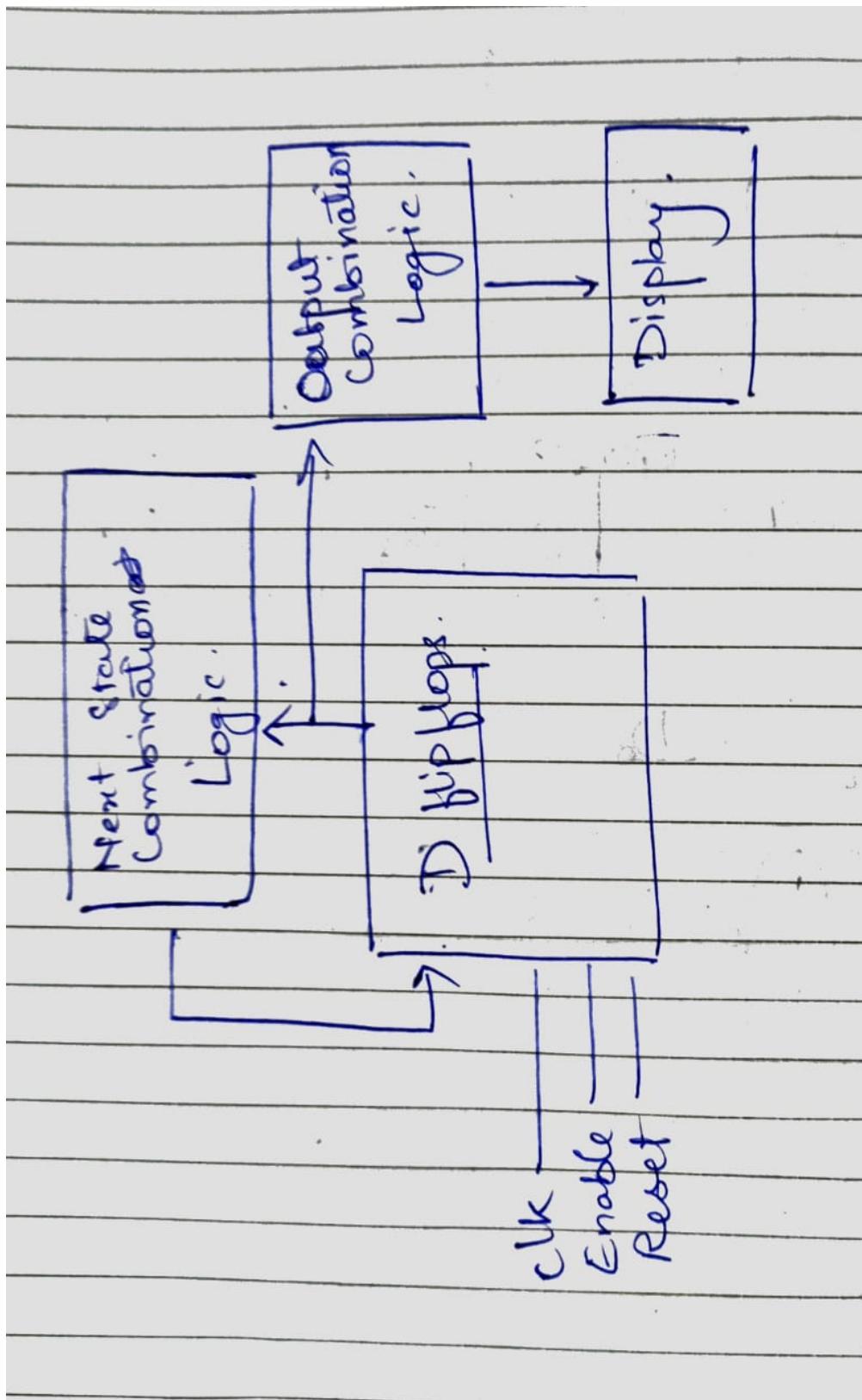
| D ₂ D ₁ = | | | | |
|---------------------------------|----------------|----|----|----|
| 00 | 01 | 02 | 03 | 04 |
| 0. | Q ₂ | 0. | 1 | |

D0 :

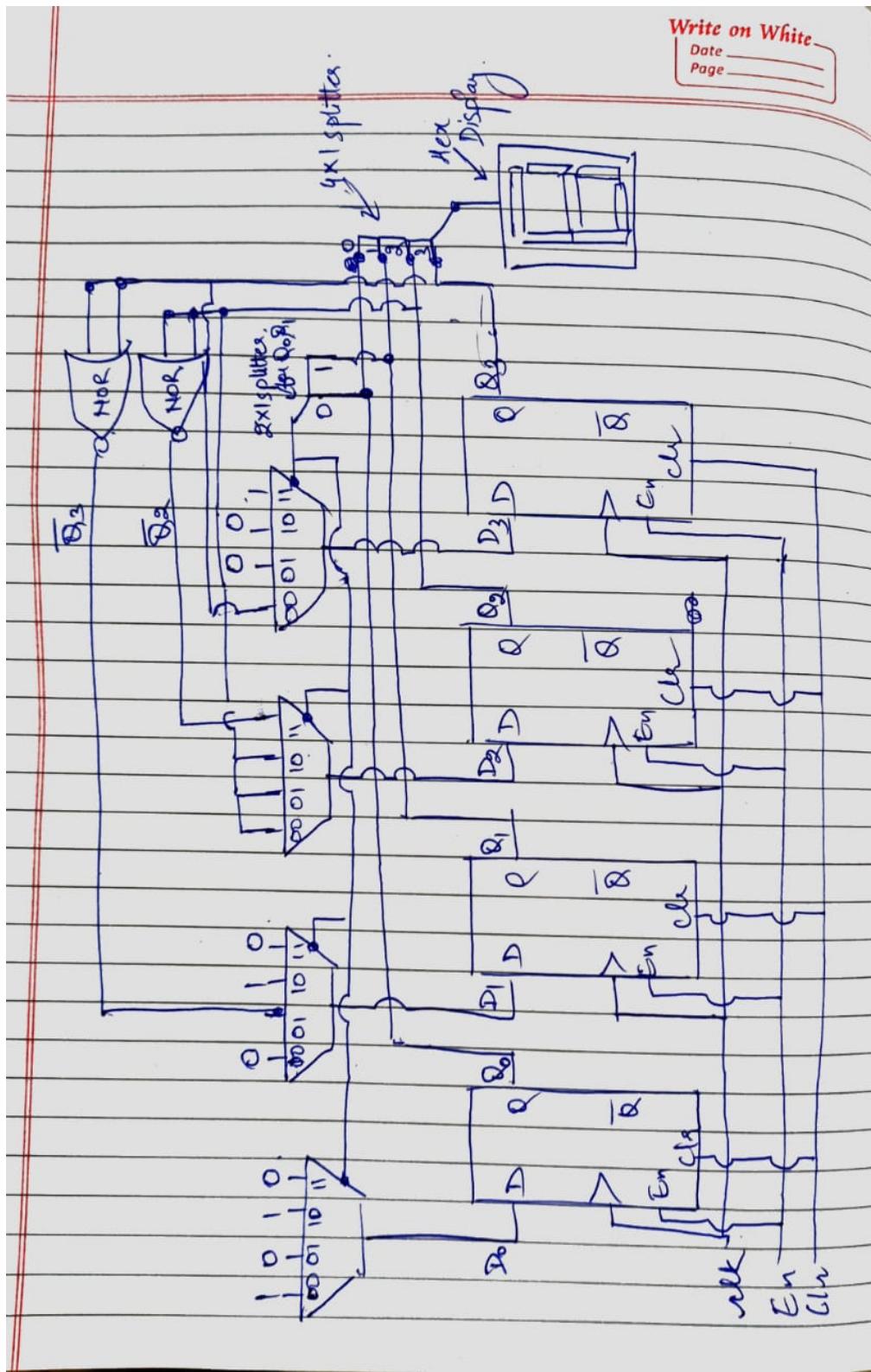
| D ₀ | | | | |
|----------------|-----------------|-----------------|-----------------|-----------------|
| 00 | 01 | 02 | 03 | 04 |
| 1 | 0 ₁ | 0 ₃ | 1 ₂ | |
| 0 ₁ | 1 ₄ | 0 ₅ | 0 ₇ | 1 ₆ |
| 0 ₂ | Φ ₁₂ | Φ ₁₃ | Φ ₁₅ | Φ ₁₄ |
| 0 ₃ | 1 ₈ | 0 ₉ | Φ ₁₁ | Φ ₁₀ |

| D ₀ = | | | | |
|------------------|----|----|----|----|
| 00 | 01 | 02 | 03 | 04 |
| 1 | 0 | 0 | 1 | |

Block Diagram :



Circuit Diagram :



Observations :

The given circuit counts numbers from 0 to 9 and then repeats itself.

When the value of enable becomes 0 then the counting stops at that number and the number doesn't change. When Enable is changed back to 1 then the counter starts counting from the number on which it had stopped.

When the value of Reset is given as 1 then the counting stops and counter resets to 0. When Reset is changed back to 0, then counting starts from 0.

Applications :

1. They can be used in alarm clocks and setting timers for AC .
2. They can be used to count the allotted time.
3. They can be used as a frequency divider.