



SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB231 – DIGITAL ELECTRONICS

II YEAR/ III SEMESTER

UNIT 3 – SEQUENTIAL CIRCUITS

TOPIC – Modulo n Counters



Modulus Counter (MOD-N Counter)



The 2-bit counter is called as MOD-4 counter and 3-bit counter is called as MOD-8 counter. So in general, an n-bit counter is called as modulo-N counter. Where, MOD number = 2^n .

- 2-bit up or down (MOD-4)
- 3-bit up or down (MOD-8)
- 4-bit up or down (MOD-16)



Design Synchronous MOD-6 Counter Using JK flip flop

Step 1 : Find number of flip-flops required to build the counter.

Flip-flops required are : $2^n \geq N$.

Here $N = 6 \quad \therefore n = 3$

i.e. Three flip-flops are required.

Step 2 : Write an excitation table for JK flip-flop.

| Q_n | Q_{n+1} | J | K |
|-------|-----------|---|---|
| 0 | 0 | 0 | X |
| 0 | 1 | 1 | X |
| 1 | 0 | X | 1 |
| 1 | 1 | X | 0 |



Design Synchronous MOD-6 Counter Using JK flip flop



Step 3 : Determine the transition table.

| Present state | | | Next state | | | Flip-flop inputs | | | | | |
|----------------|----------------|----------------|------------------|------------------|------------------|------------------|----------------|----------------|----------------|----------------|----------------|
| Q _A | Q _B | Q _C | Q _{A+1} | Q _{B+1} | Q _{C+1} | J _A | K _A | J _B | K _B | J _C | K _C |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | x | 0 | x | 1 | x |
| 0 | 0 | 1 | 0 | 1 | 0 | 0 | x | 1 | x | x | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 | 0 | x | x | 0 | 1 | x |
| 0 | 1 | 1 | 1 | 0 | 0 | 1 | x | x | 1 | x | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 | x | 0 | 0 | x | 1 | x |
| 1 | 0 | 1 | 0 | 0 | 0 | x | 1 | 0 | x | x | 1 |
| 1 | 1 | 0 | x | x | x | x | x | x | x | x | x |
| 1 | 1 | 1 | x | x | x | x | x | x | x | x | x |



Design Synchronous MOD-6 Counter Using JK flip flop



Step 4 : K-map simplification for flip-flop inputs.

For J_A

| | | | | |
|-----------|----|----|----|----|
| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
| Q_A 0 | 0 | 0 | 1 | 0 |
| Q_A 1 | X | X | X | X |

$J_A = Q_B Q_C$

For K_A

| | | | | |
|-----------|----|----|----|----|
| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
| Q_A 0 | X | X | X | X |
| Q_A 1 | 0 | 1 | X | X |

$K_A = Q_C$

For J_B

| | | | | |
|-----------|----|----|----|----|
| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
| Q_A 0 | 0 | 1 | X | X |
| Q_A 1 | 0 | 0 | X | X |

$J_B = \bar{Q}_A Q_C$

For K_B

| | | | | |
|-----------|----|----|----|----|
| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
| Q_A 0 | X | X | 1 | 0 |
| Q_A 1 | X | X | X | X |

$K_B = Q_C$

For J_C

| | | | | |
|-----------|----|----|----|----|
| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
| Q_A 0 | 1 | X | X | 1 |
| Q_A 1 | 1 | X | X | X |

$J_C = 1$

For K_C

| | | | | |
|-----------|----|----|----|----|
| $Q_B Q_C$ | 00 | 01 | 11 | 10 |
| Q_A 0 | X | 1 | 1 | X |
| Q_A 1 | X | 1 | X | X |

$K_C = 1$



Design Synchronous MOD-6 Counter Using JK flip flop



Step 5 : Implement the counter.

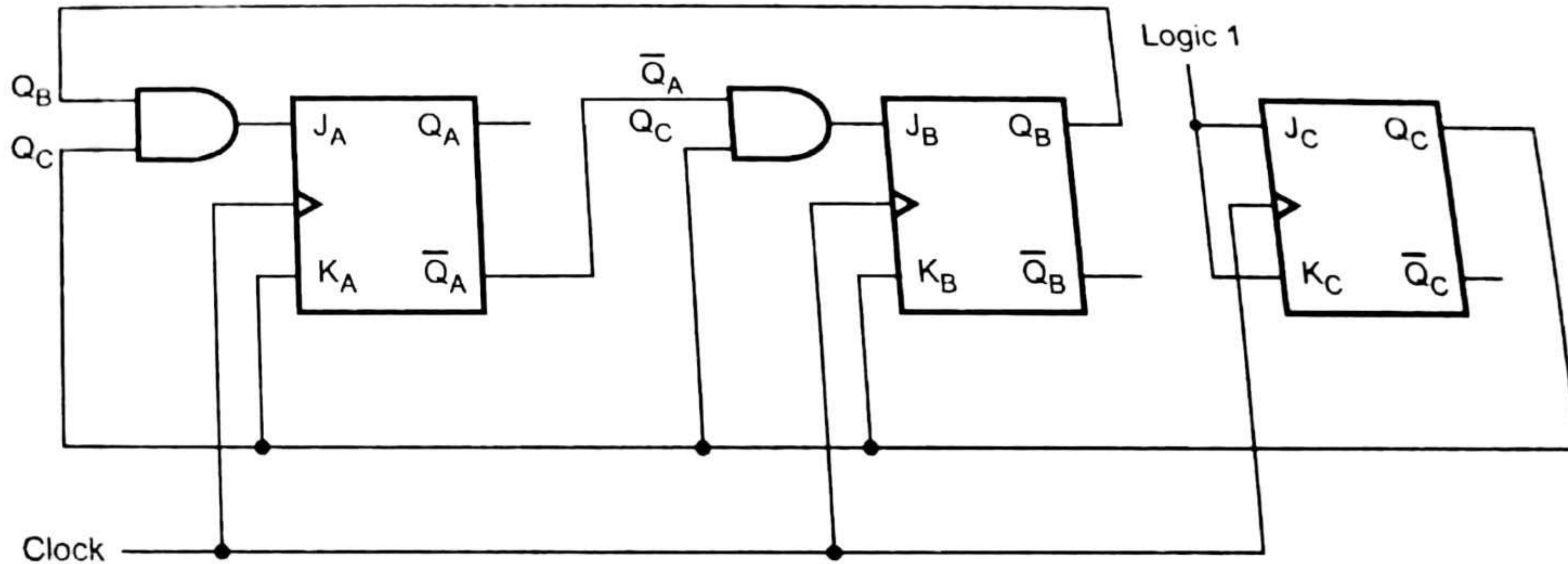


Fig. 7.79 Implementation of MOD 6 synchronous counter



Design Synchronous MOD-6 Counter Using D flip flop



Step 1 : Find number of flip-flops required to build the counter.

Flip-flops required are : $2^n \geq N$

Here $N = 6 \therefore n = 3$

i.e. Three flip-flops are required.



Design Synchronous MOD-6 Counter Using D flip flop



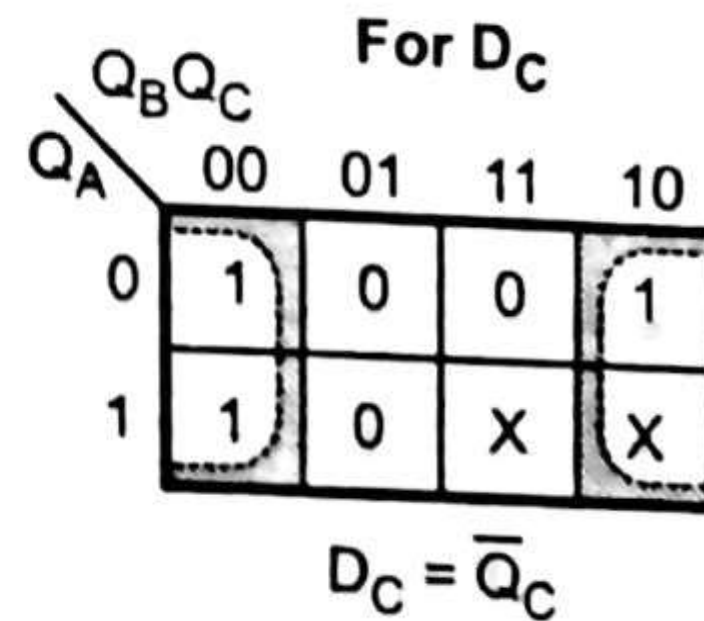
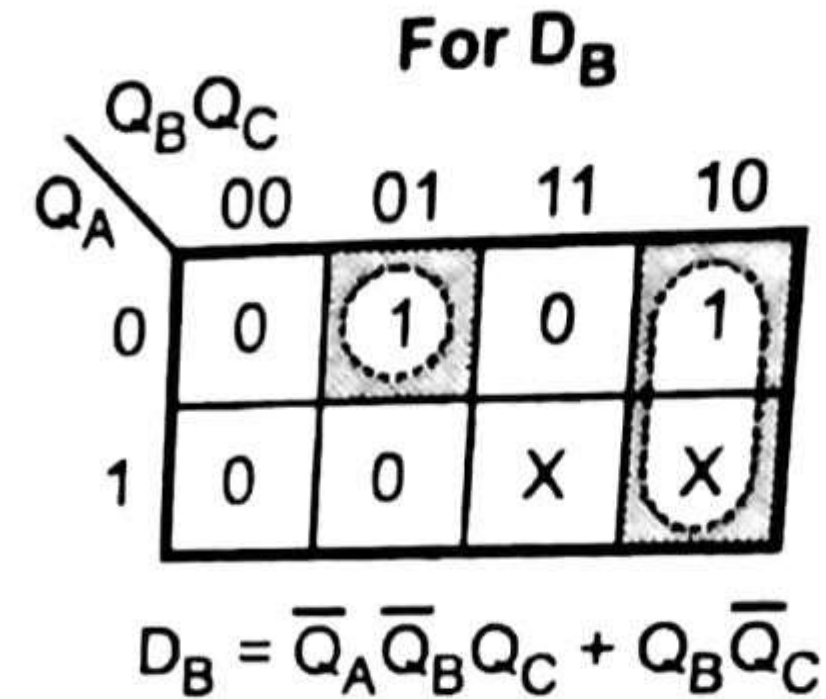
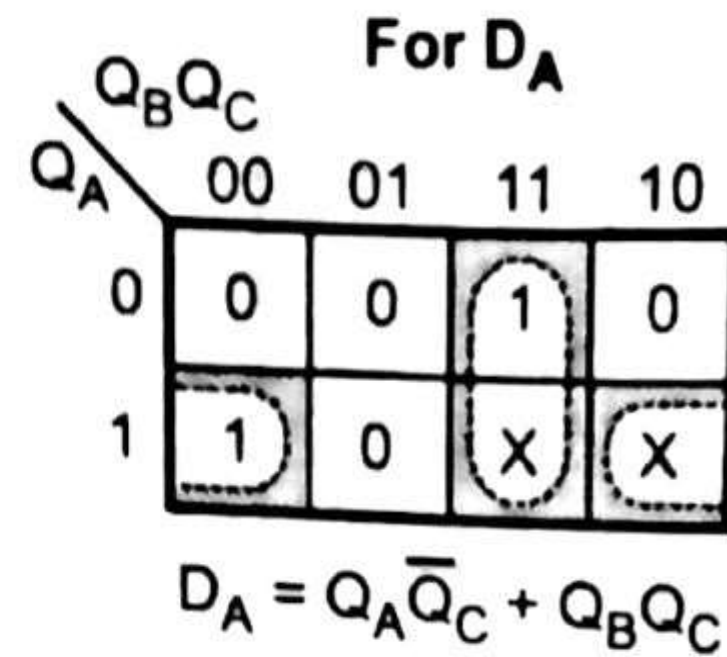
Step 2 : Determine the transition table.

| Present state | | | Next state | | |
|---------------|-------|-------|------------|-----------|-----------|
| Q_A | Q_B | Q_C | Q_{A+1} | Q_{B+1} | Q_{C+1} |
| 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | x | x | x |
| 1 | 1 | 1 | x | x | x |



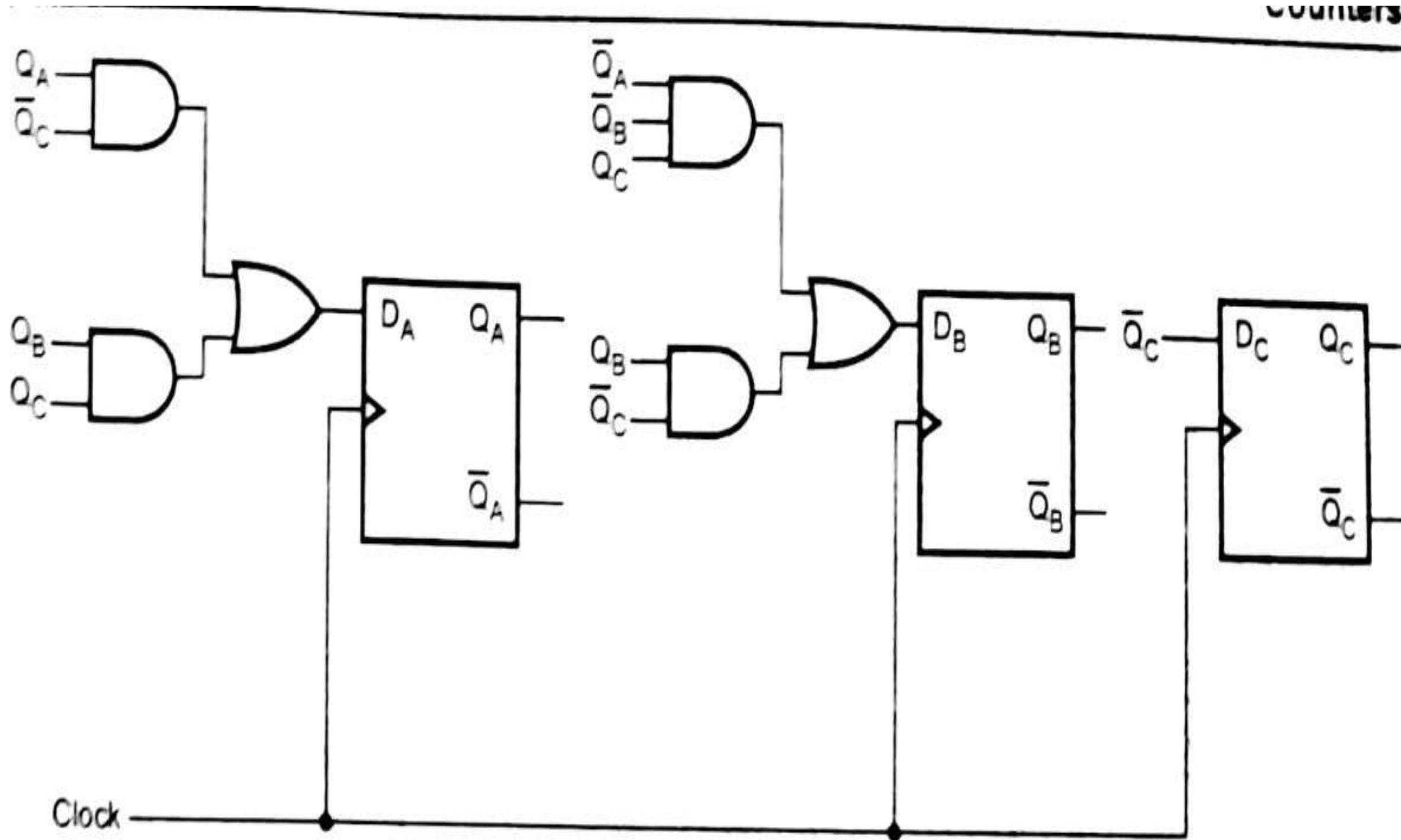
Design Synchronous MOD-6 Counter Using D flip flop

Step 3 : K-map simplification for flip-flop inputs.





Design Synchronous MOD-6 Counter Using D flip flop





ASSESSMENTS



- 1.What is MOD N Counter?
- 2.Design MOD 5 counter using T flip flop.
- 3.Difference between synchronous and Asynchronous counter .



THANK YOU