Digital Systems - Homework 06 - Group 5

Group members

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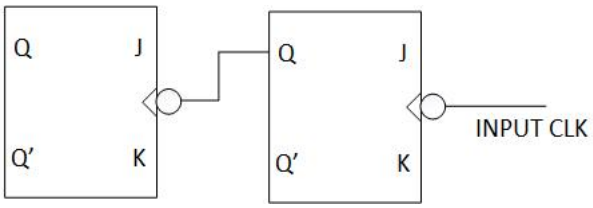
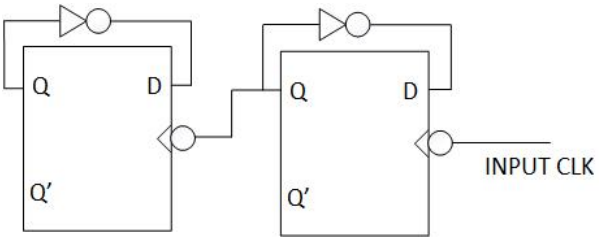
Problem 1. Ripple MOD4 Counter

- **JK FF**

  Note: All J and K inputs are connected to 1.



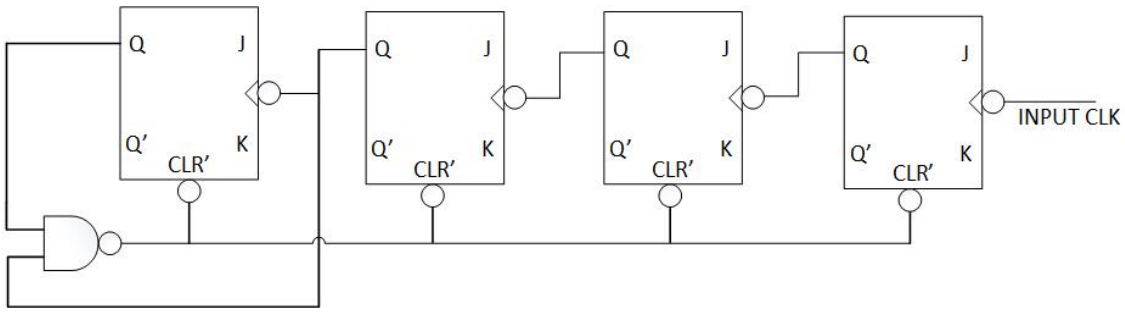
- **D FF**



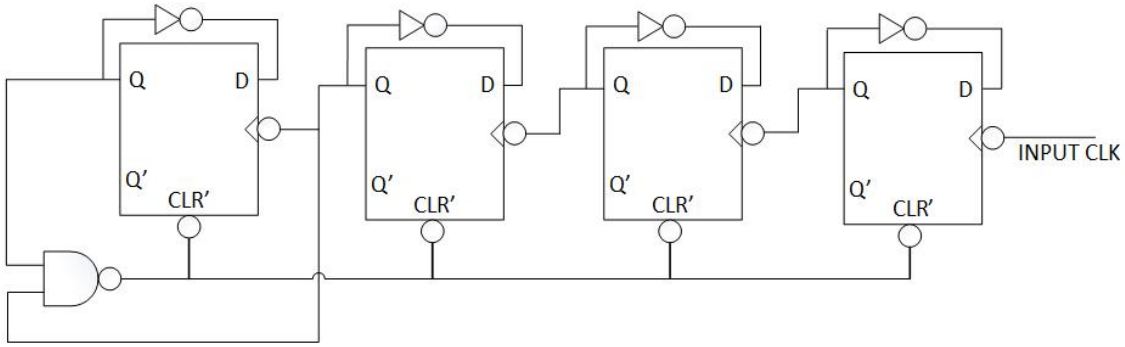
Problem 2. Ripple MOD12 Counter

- **JK FF**

  Note: All J and K inputs are connected to 1.



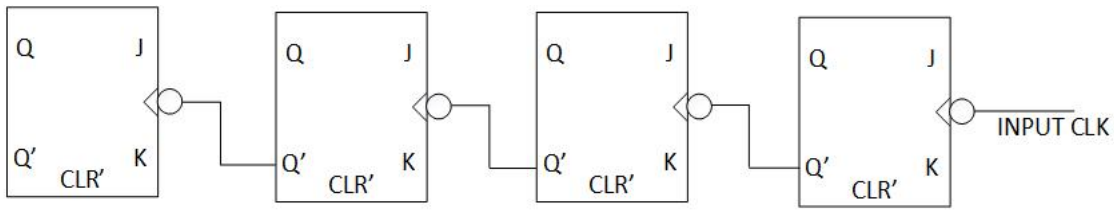
- **D FF**



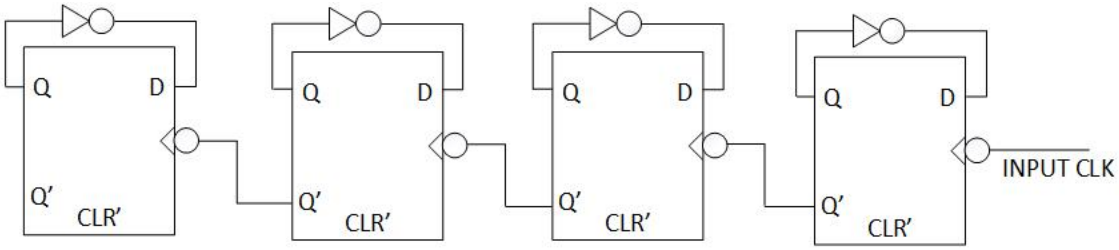
Problem 3. Ripple MOD16 Counter

- **JK FF**

  Note: All J and K inputs are connected to 1.



- **D FF**



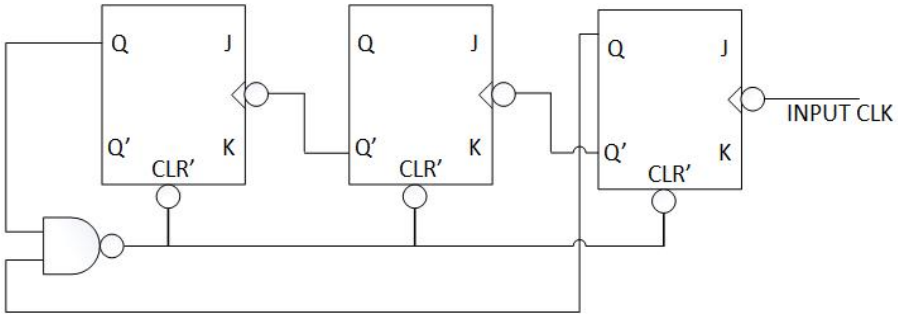
- Suppose the counter is in state 0110, determines the state of the counter after the next 27 clock cycles.

  $(0110_2 + 27_{10})|16$
  $= (6_{10} + 27_{10})|16$
  $= 33|16$
  $= 1_{10} = 0001_2$

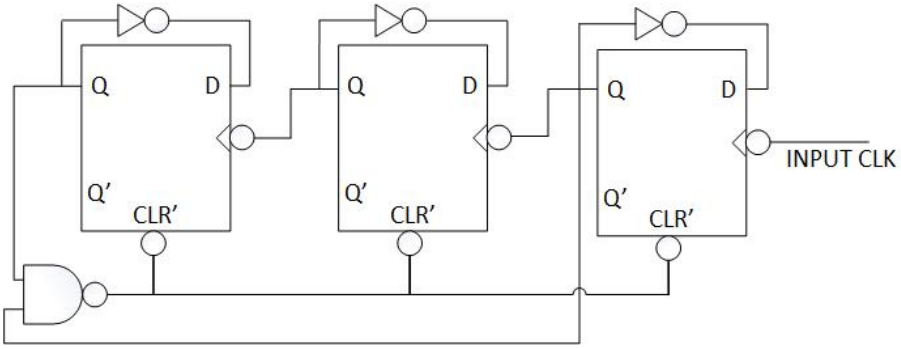
Problem 4. Ripple MOD5 Counter

- **JK FF**

  Note: All J and K inputs are connected to 1.



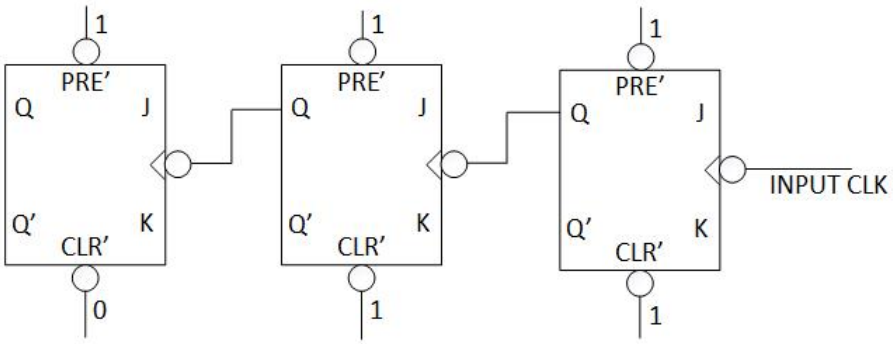
- **D FF**



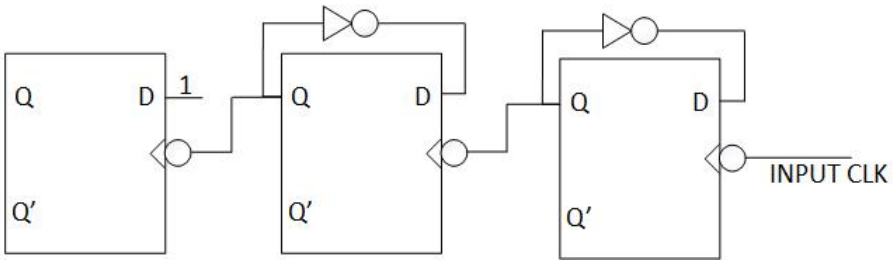
Problem 5. Asynchronous counter with sequence: $4 \to 5 \to 6 \to 7 \to 4$.

- **JK FF**

  Note: All J and K inputs are connected to 1.



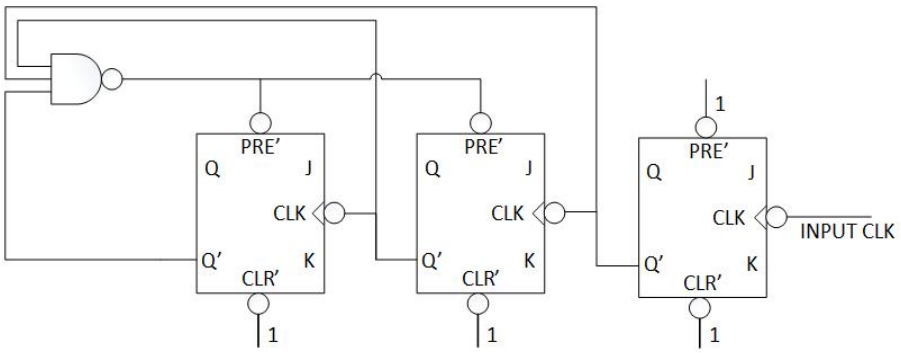
- **D FF**



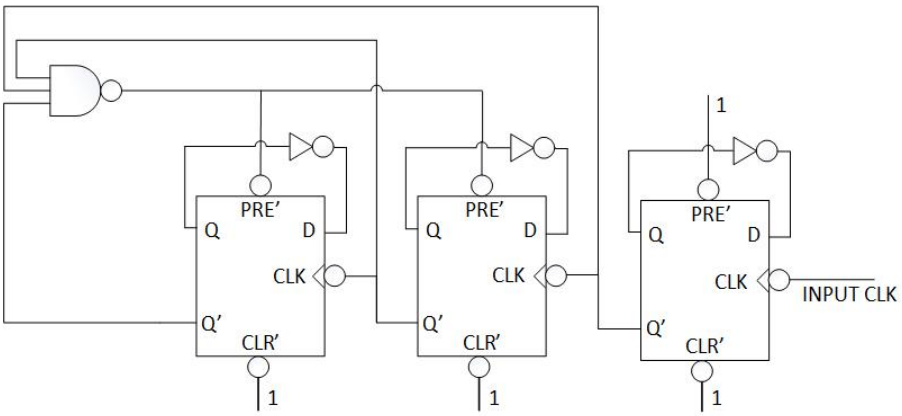
Problem 6. Asynchronous counter with sequence: $6 \to 5 \to 4 \to 3 \to 2 \to 1 \to 6$.

- **JK FF**

  Note: All J and K inputs are connected to 1.



- **D FF**



Problem 7.

(a) MOD of the counter:

- U_1: MOD10
- U_2: MOD7

$\Rightarrow$ MOD of the counter: $10 \times 7 = 70$.

(b) Frequency of Q_3 of U_1:

$$35000/2^4 = 2187.5(Hz)$$

(c) Frequency of Q_2 of U_2:

$$35000/2^7 = 273.4375(Hz)$$

(d) Glitches:

- U_1: Q_1, Q_3
- U_2: Q_0, Q_1, Q_2

(e) Duty cycle of Q_2 of U_2:

$$\frac{1}{35000/2^7} \times 50\% = 0.0018(s)$$

Problem 8.

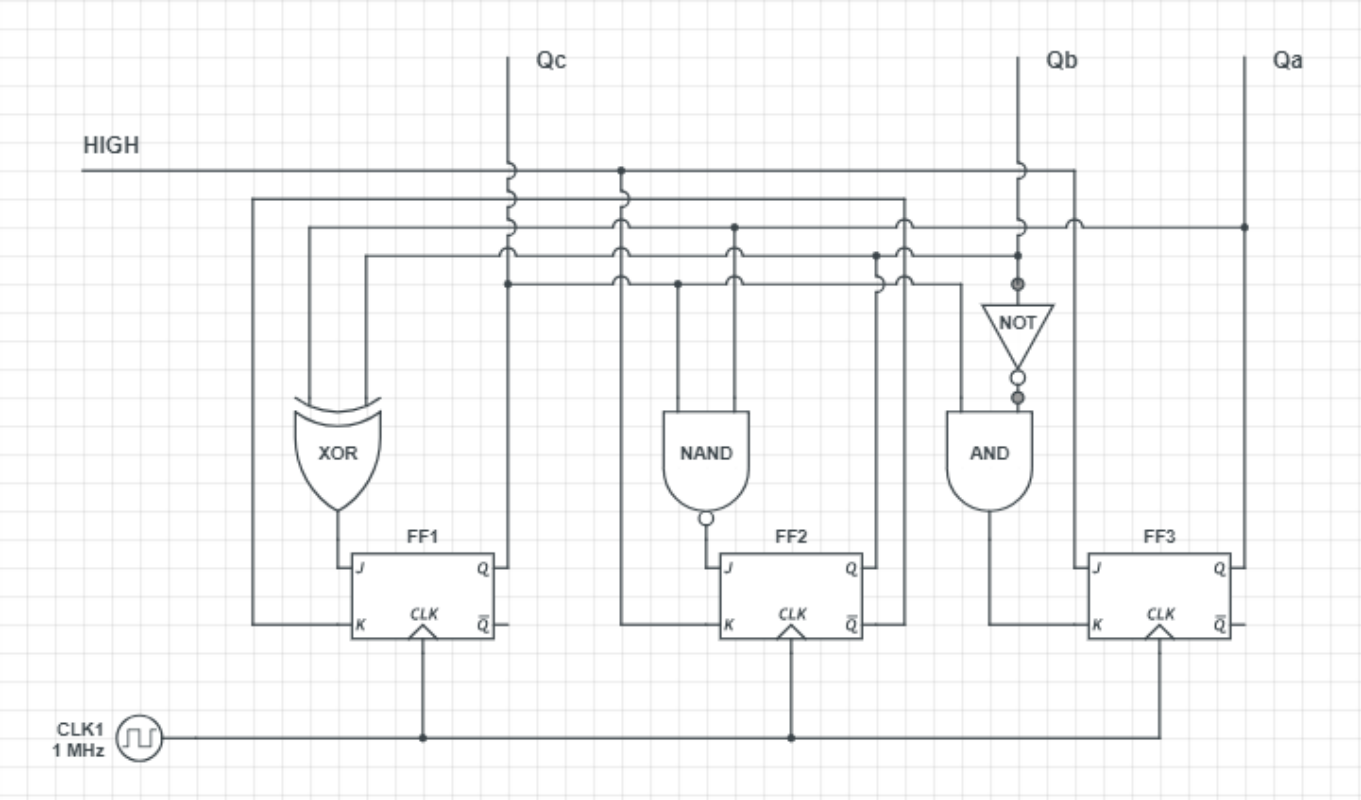
(a) MOD of the counter: MOD12

(b) Glitches: C and D

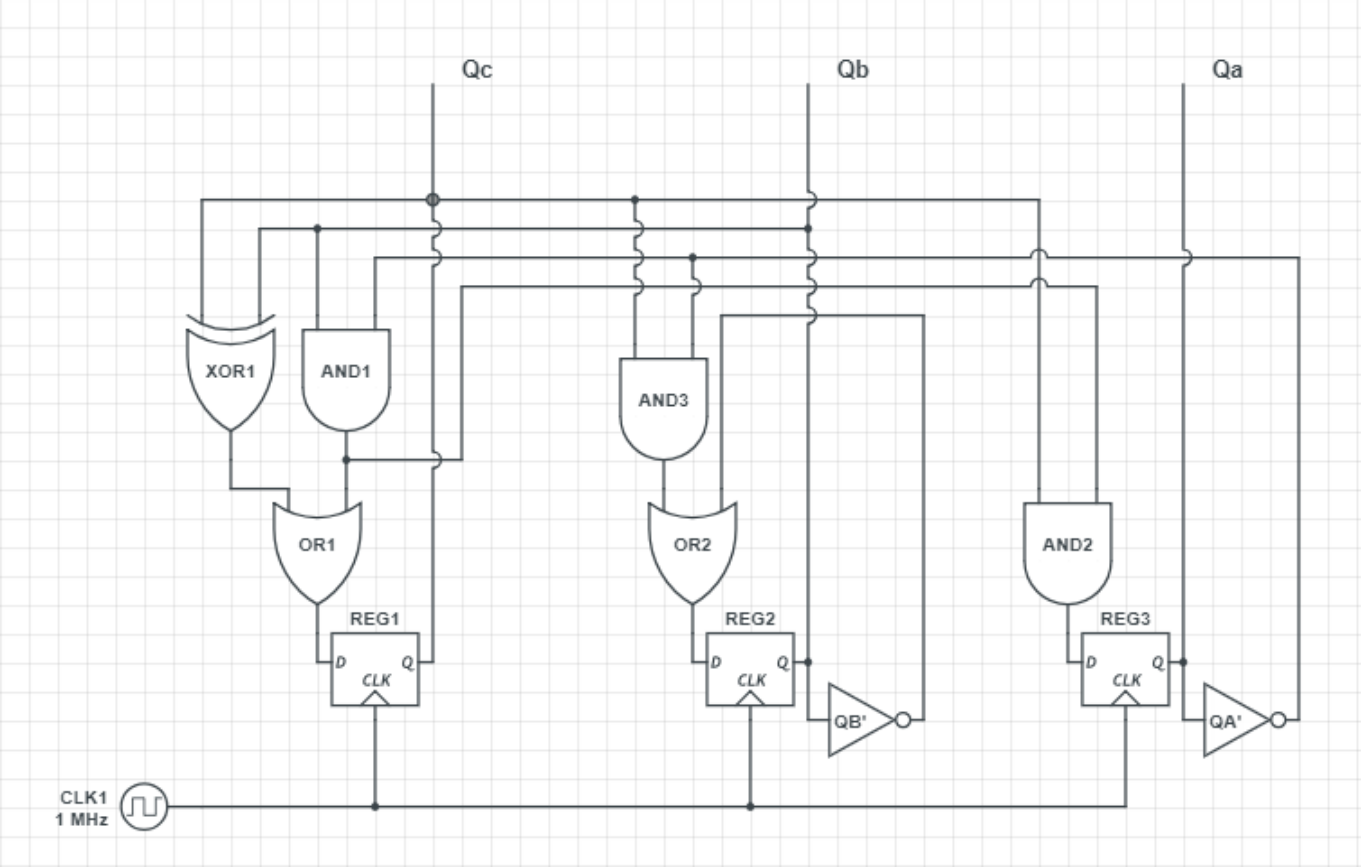
(c) $f(B) = \frac{1}{2^2} f(CLK)$

(d) $f(D) = \frac{1}{2^4} f(CLK)$

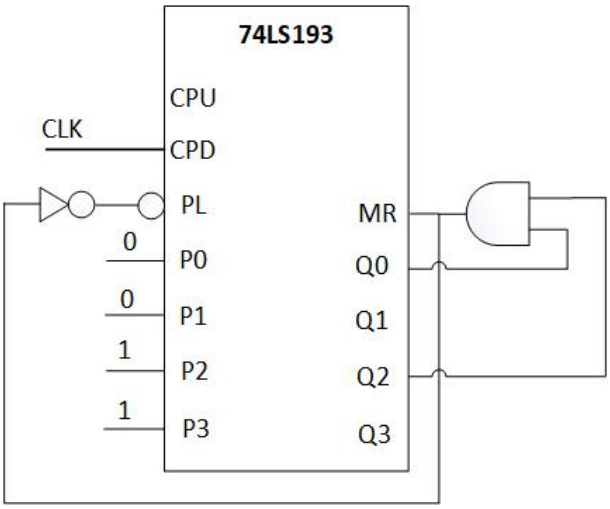
Problem 9.


Qc
Qb
Qa
HIGH
NOT
XOR
NAND
AND
FF1
FF2
FF3
J
K
CLK
Q
$\overline{Q}$
CLK1
1 MHz

Problem 10.


Qc
Qb
Qa
XOR1
AND1
AND3
OR1
OR2
AND2
REG1
REG2
REG3
D
Q
CLK
QB'
QA'
CLK1
1 MHz

Problem 11.



Problem 12.

$$000(\text{initial}) \to 100 \to 110 \to 111 \to 011 \to 001 \to 000(\text{initial})$$

Problem 13.

$$010(\text{initial}) \to 001 \to 000 \to 100 \to 011 \to 010(\text{initial})$$

Problem 14.

$$010(\text{initial}) \to 011 \to 100 \to 101 \to 110 \to 111 \to 000 \to 001 \to 010(\text{initial})$$