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17BIT0028

EXPERIMENT - 5.

Q. Design a mod 16 counter using J-K flip-flop.

P.S.

N.S.

| A | B | C | D | A | B | C | D | J ₁ | K ₁ | J ₂ | K ₂ | J ₃ | K ₃ | J ₄ | K ₄ |
|---|---|---|---|---|---|---|---|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | X | 0 | X | 0 | X | 1 | X |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | X | 0 | X | 1 | X | X | 1 |
| 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | X | 0 | X | X | 0 | 1 | X |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | X | 1 | X | X | 1 | X | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | X | X | X | 0 | X | 1 | X |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | X | X | X | 1 | X | X | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | X | X | X | X | 0 | 1 | X |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | X | X | X | X | 1 | X | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | X | 0 | X | X | 0 | X | 1 | X |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | X | 0 | X | X | 1 | X | X | 1 |
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | X | 0 | X | X | X | 0 | 1 | X |
| 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | X | 0 | 1 | X | X | 1 | X | 1 |
| 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | X | 0 | X | 0 | 0 | X | 1 | X |
| 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | X | 0 | X | 0 | 1 | X | X | 1 |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | X | 0 | X | 0 | X | 0 | 1 | X |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | X | 0 | X | 1 | X | 1 | X | 1 |

$J_2 = AB$

| AB \ CD | 00 | 01 | 11 | 10 |
|---------|-----------------|-----------------|-----------------|-----------------|
| 00 | 0 | 1 | 1 | 2 |
| 01 | X ₄ | X ₅ | X ₇ | X ₆ |
| 11 | X ₁₂ | X ₁₃ | X ₁₅ | X ₁₄ |
| 10 | X ₈ | X ₉ | X ₁₁ | X ₁₀ |

$$J_2 = CD$$

$J_1 = AB$

| AB \ CD | 00 | 01 | 11 | 10 |
|---------|-----------------|-----------------|-----------------|-----------------|
| 00 | 0 | 1 | 3 | 2 |
| 01 | 4 | 5 | 7 | 6 |
| 11 | X ₈ | X ₉ | X ₁₁ | X ₁₀ |
| 10 | X ₁₂ | X ₁₃ | X ₁₅ | X ₁₄ |

$$= BCD = K_4$$

$K_2 = AD$

| | | | | |
|----|-------|-------|----------------|----------|
| | 00 | 01 | 11 | 10 |
| 00 | X_0 | X_1 | X_3 | X_2 |
| 01 | 4 | 5 | $\frac{1}{7}$ | 6 |
| 11 | 12 | 13 | $\frac{1}{14}$ | 15 |
| 10 | X_8 | X_9 | X_{11} | X_{10} |

$= CD$

$J_3 = AB$

| | | | | |
|----|----|----|----------|----------|
| | 00 | 01 | 11 | 10 |
| 00 | | 1 | X_3 | X_2 |
| 01 | 4 | 1 | X_7 | X_6 |
| 11 | 12 | 1 | X_{13} | X_{14} |
| 10 | 8 | 1 | X_{11} | X_{10} |

$= D$

$K_3 = AC$

| | | | | |
|----|----------|----------|----|----|
| | 00 | 01 | 11 | 10 |
| 00 | X_0 | X_1 | 1 | 2 |
| 01 | X_4 | X_5 | 1 | 6 |
| 11 | X_{12} | X_{13} | 1 | 14 |
| 10 | X_8 | X_9 | 1 | 10 |

$= D$

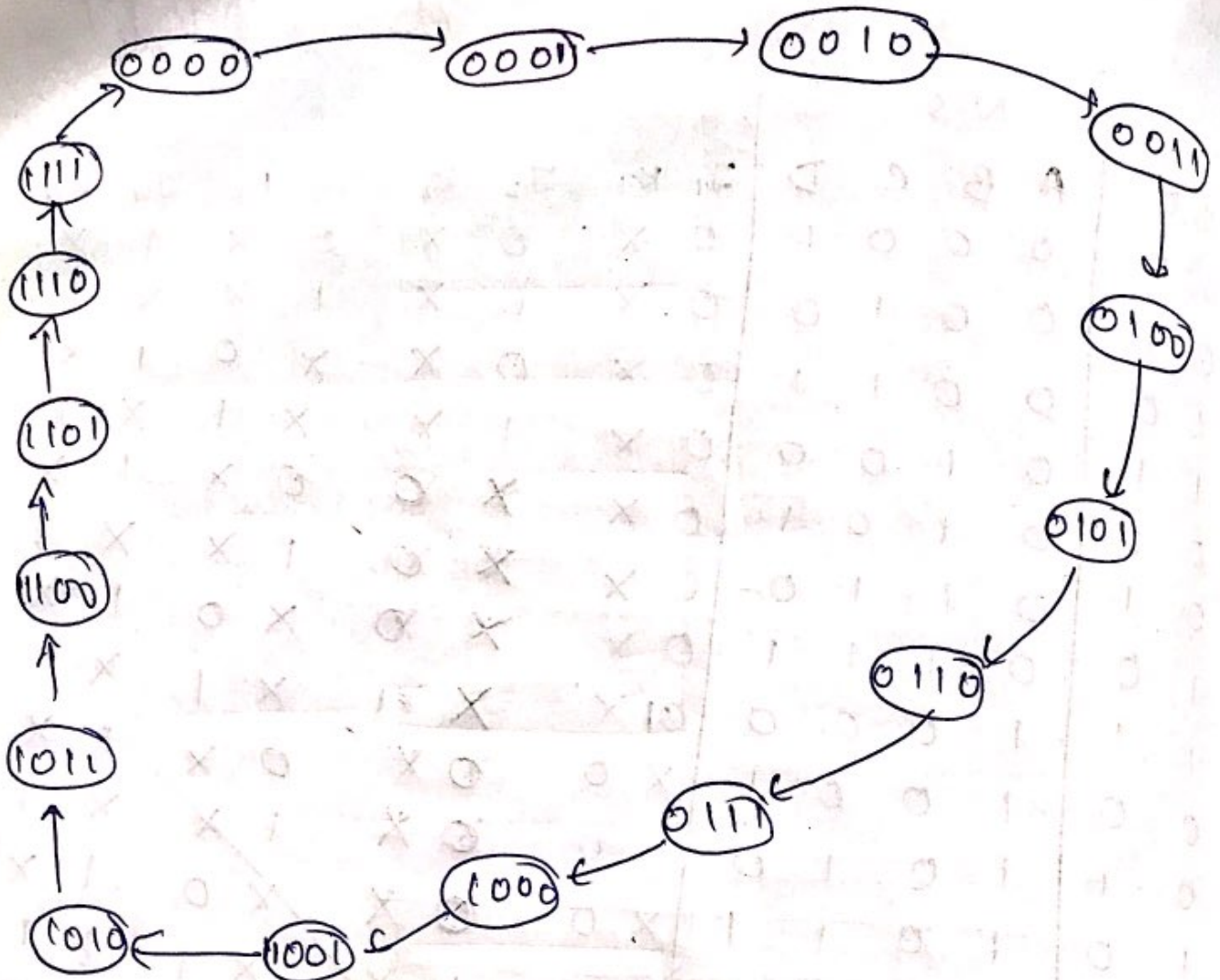
$J_4 = AD$

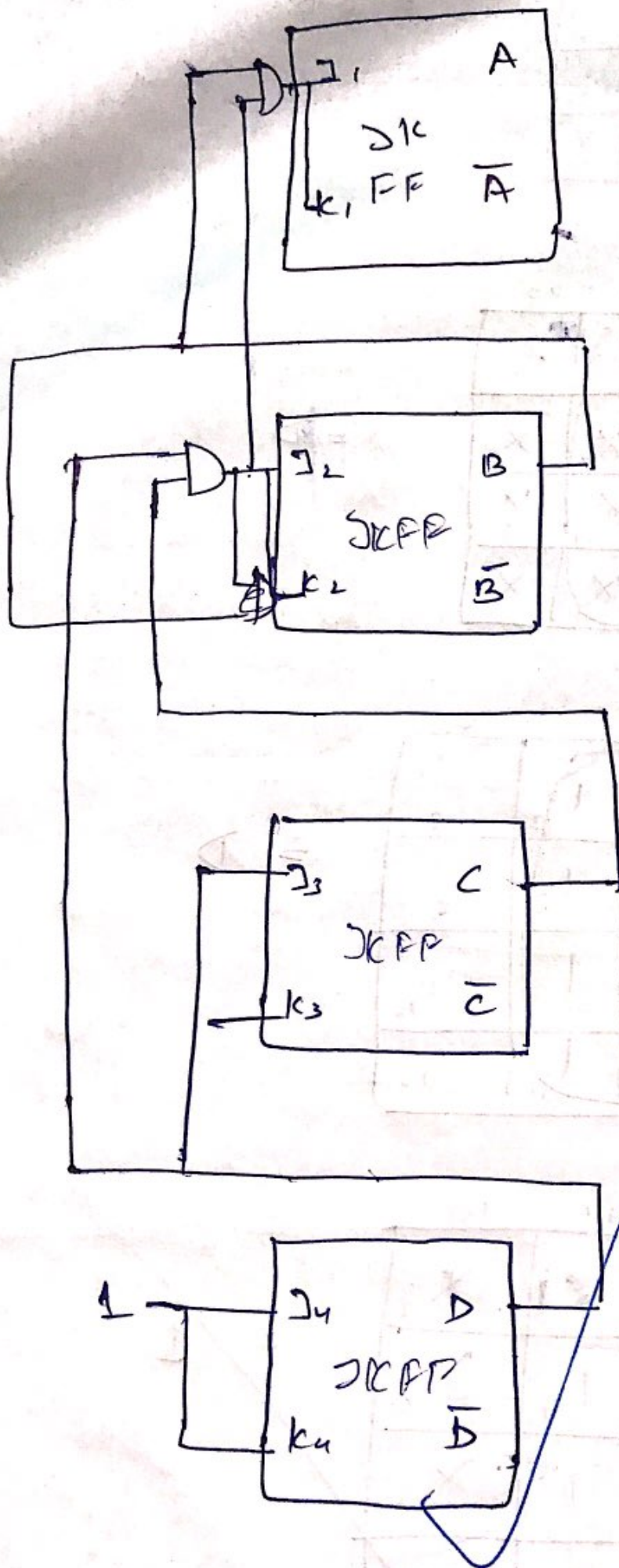
| | | | | |
|----|----|----------|-------|----------|
| | 00 | 01 | 11 | 10 |
| 00 | 1 | X_1 | X_3 | X_2 |
| 01 | 1 | X_5 | 1 | X_6 |
| 11 | 1 | X_{13} | 1 | X_{14} |
| 10 | 1 | X_9 | 1 | X_{10} |

$= 1$

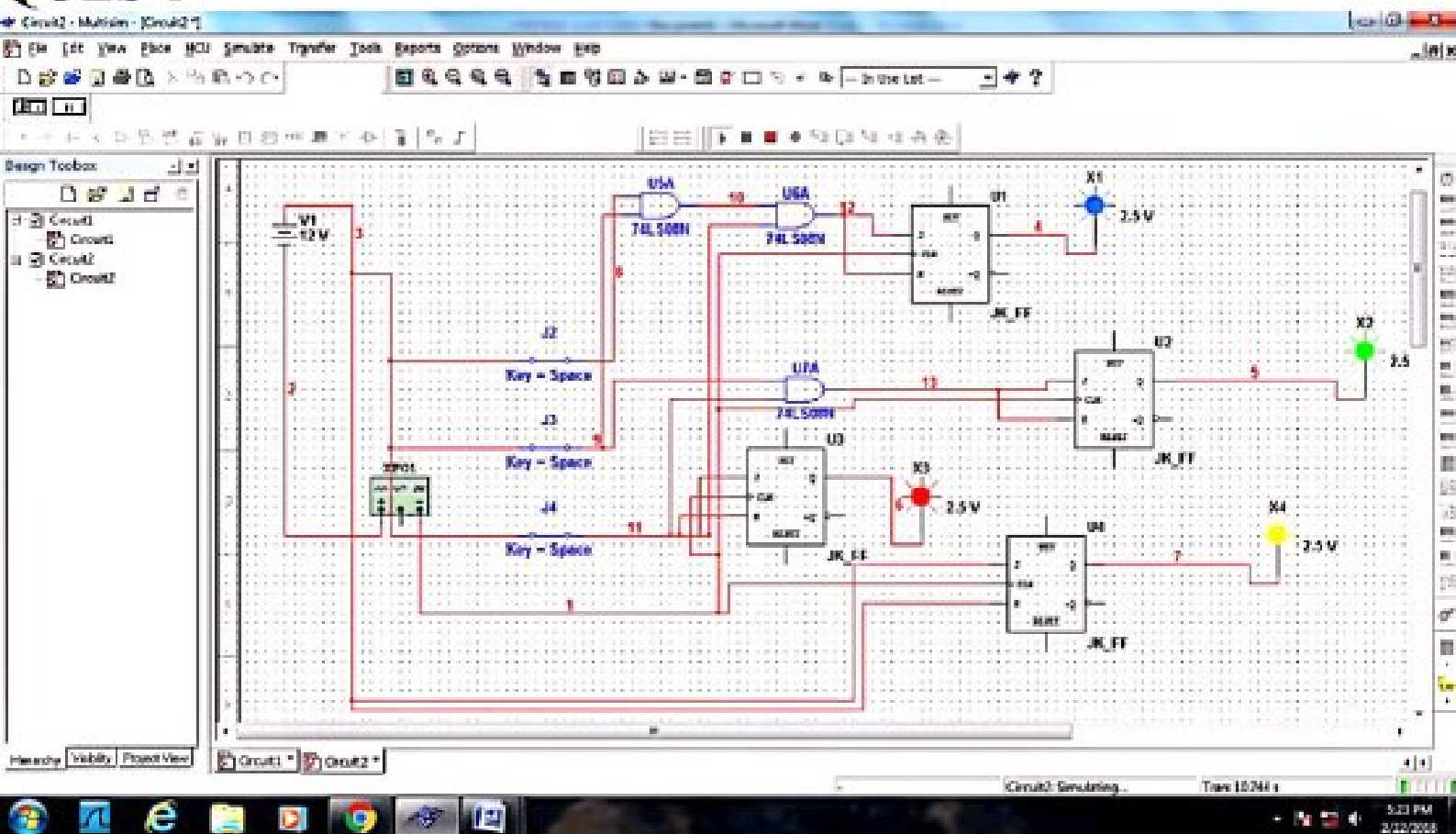
$K_4 = 1$

STATE DIAGRAM





QUES 1



Q. Design a modulus counter using T flip-flop.

P.S.

N.S.

| A | B | C | A | B | C | T_A | T_B | T_C |
|---|---|---|---|---|---|-------|-------|-------|
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |

$$T_A = \Sigma(3, 7) = BC$$

| A | BC | | | |
|----|----|----|----|----|
| | 00 | 01 | 11 | 10 |
| 00 | 0 | 1 | 1 | 2 |
| 01 | 4 | 5 | 1 | 6 |

$$= BC$$

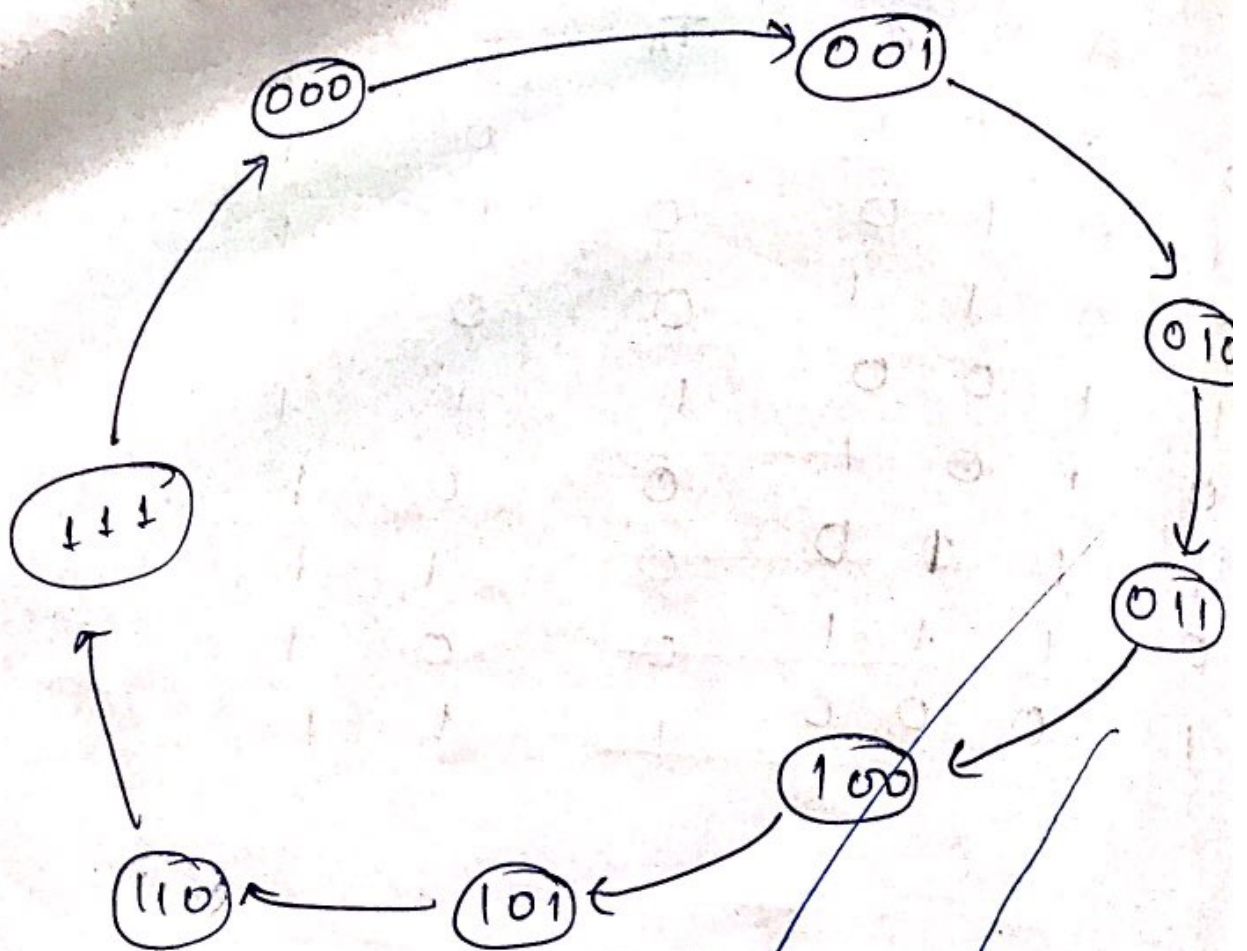
$$T_B = \Sigma(1, 3, 5, 7) = C$$

| A | BC | | | |
|----|----|----|----|----|
| | 00 | 01 | 11 | 10 |
| 00 | 0 | 1 | 1 | 2 |
| 01 | 4 | 1 | 1 | 6 |

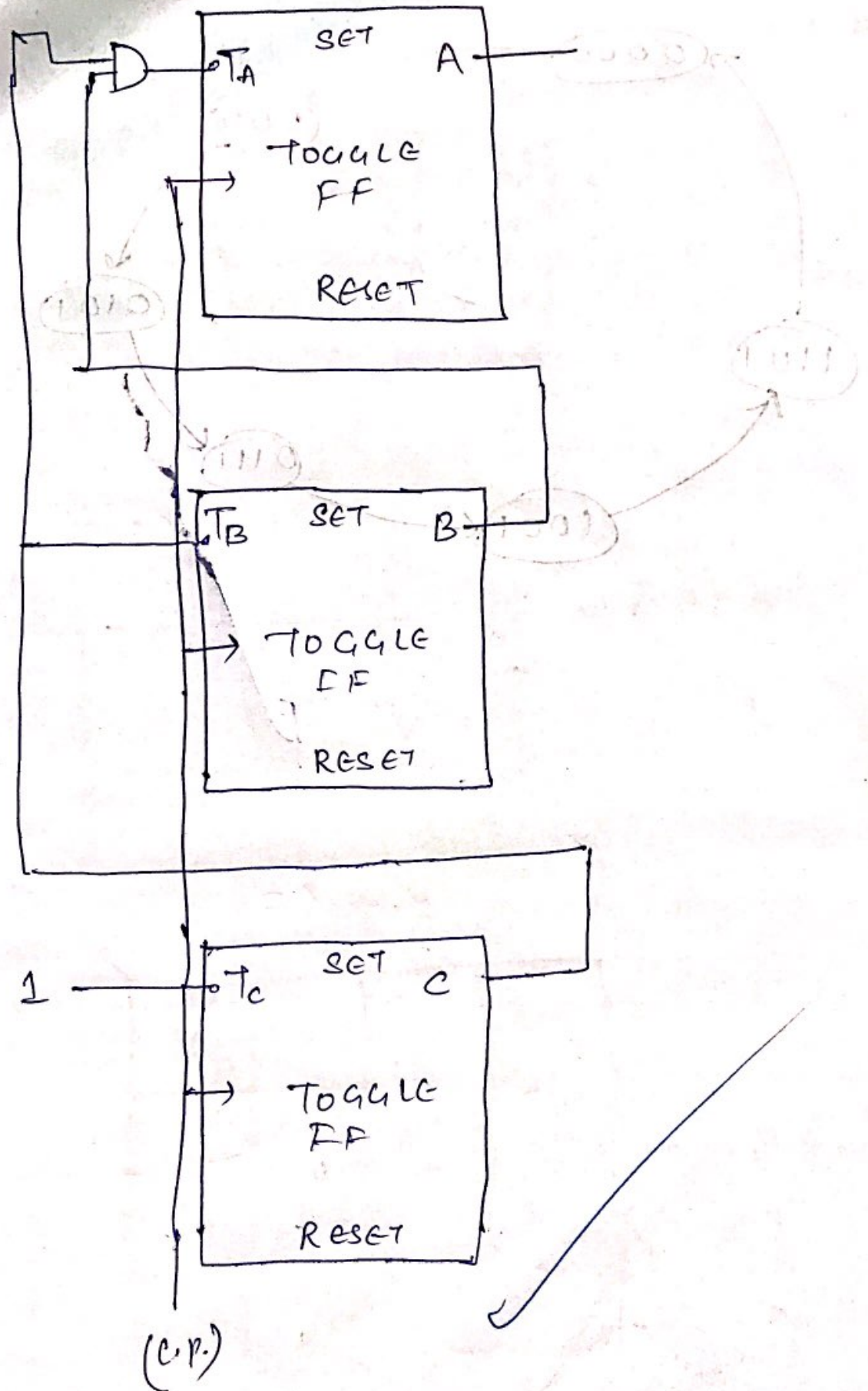
$$= C$$

$$T_C = 1$$

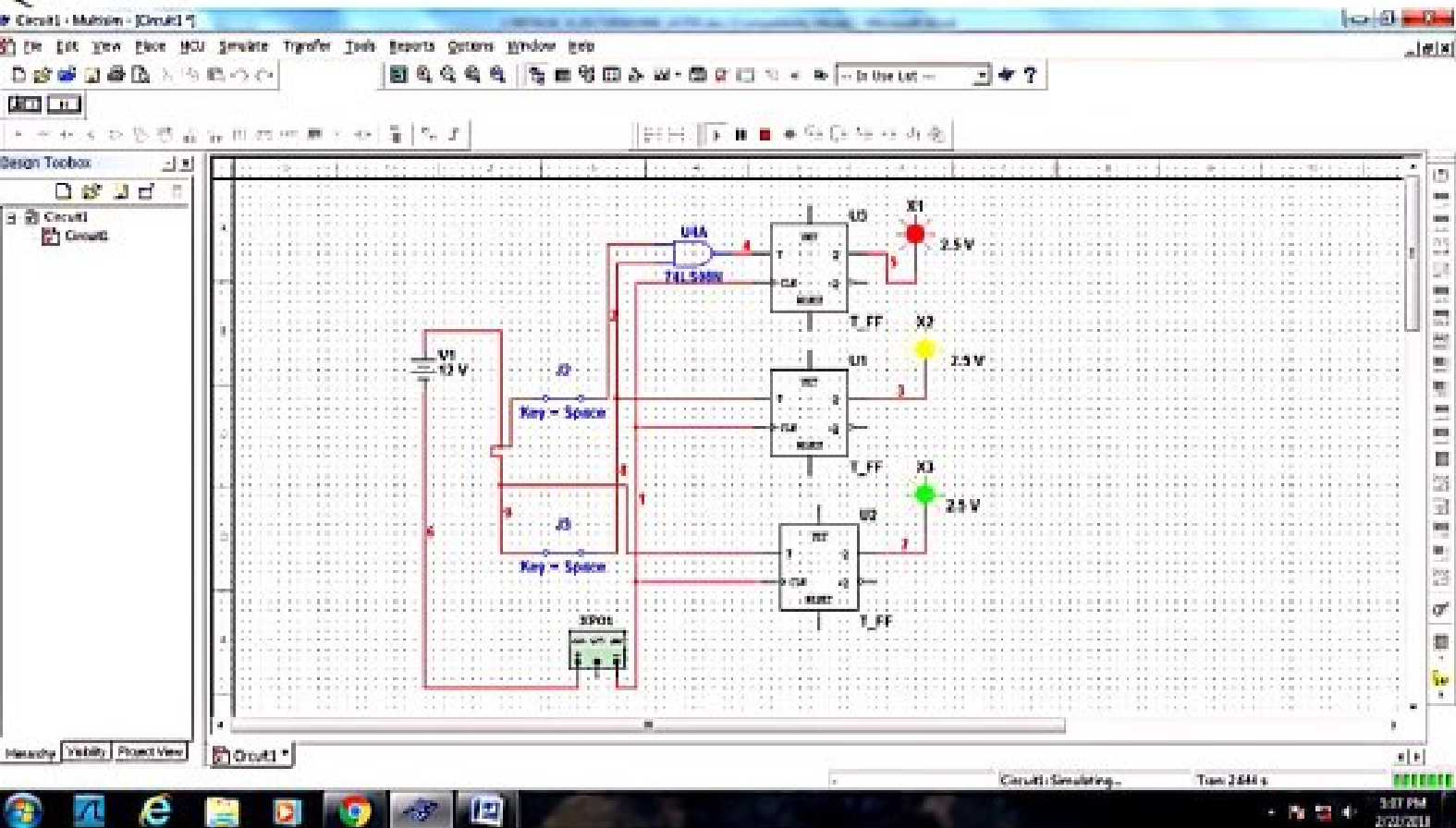
STATE DIAGRAM



HARDWARE STATE



QUES 2



Q. Design a counter for the following sequence:-
 0, 2, 5, 7, 9, 13, 0 - - - using J-K
 flip-flop.

| A | B | C | D | J ₁ k ₁ | J ₂ k ₂ | J ₃ k ₃ | J ₄ k ₄ | A | B | C | D |
|---|---|---|---|-------------------------------|-------------------------------|-------------------------------|-------------------------------|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 X | 0 X | 1 X | 0 X | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 X | 1 X | X 1 | 1 X | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 X | X 0 | 1 X | X 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 X | X 1 | X 1 | X 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | X 0 | 1 X | 0 X | X 0 | 1 | 1 | 0 | 1 |
| 1 | 1 | 0 | 1 | X 1 | X 1 | 0 X | X 1 | 0 | 0 | 0 | 0 |

J₁ =

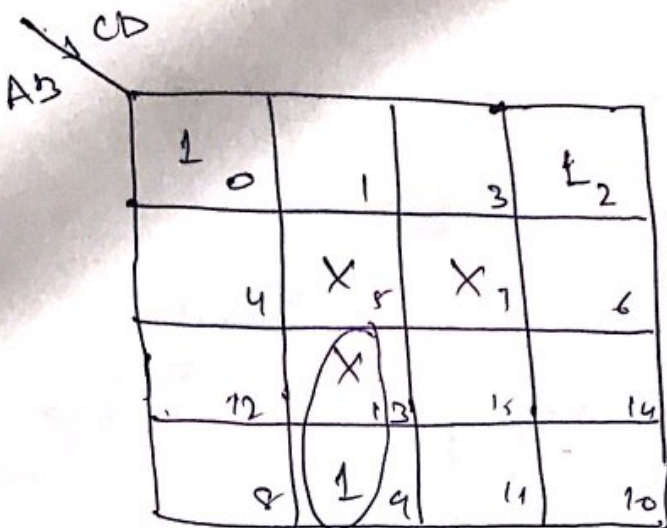
| | | | | |
|----|---|----|----|----|
| | 0 | 1 | 3 | 2 |
| | | | 1 | |
| 4 | 5 | 7 | 6 | |
| 12 | X | 13 | 15 | 14 |
| 8 | X | 9 | 11 | 10 |

= $\bar{A}BCD$

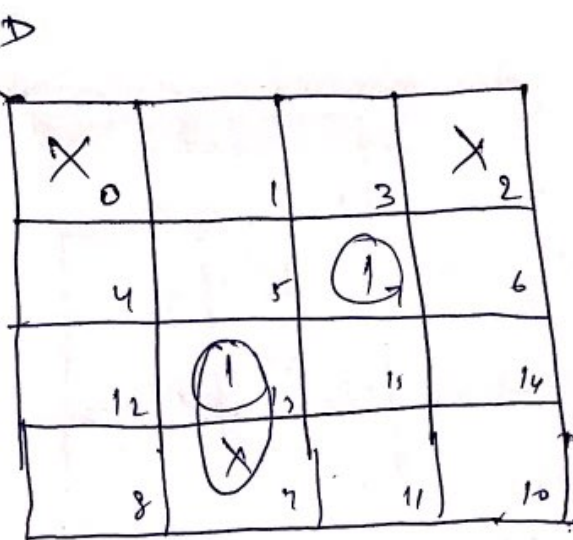
k₁ =

| | | | | | | |
|----|---|---|----|---|----|----|
| | X | 0 | 1 | 3 | X | 2 |
| | | | | | | |
| 4 | | X | 5 | X | 7 | 6 |
| | | 1 | | | | |
| 12 | | | 13 | | 15 | 14 |
| 8 | | | 9 | | 11 | 10 |

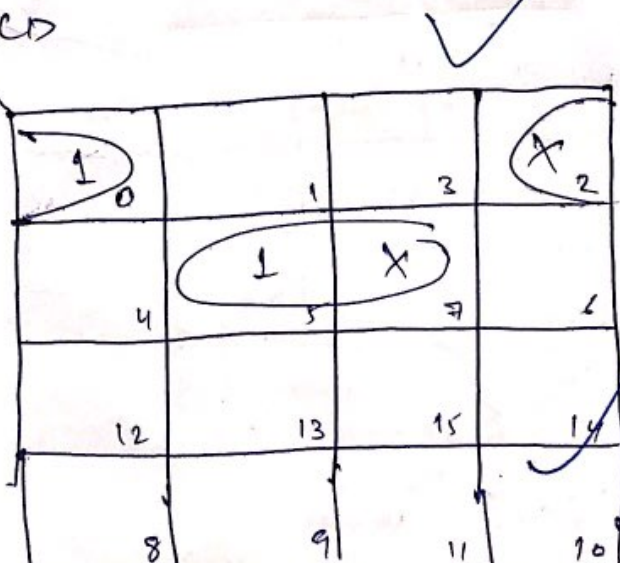
= $B\bar{C}D$

$J_2 =$ 

$$= \bar{A} \bar{B} C \bar{D} + A \bar{C} D$$

$K_2 =$ 

$$= \bar{A} B C D + A \bar{B} \bar{C} D$$

$J_3 =$ 

$$= \bar{A} \bar{B} \bar{D} + \bar{A} B \bar{C}$$

$$K_3 = A\bar{B}$$

| | | | |
|-------------|----------------|-------------|-------------|
| \bar{X}_0 | 1 | 3 | $\bar{1}_2$ |
| 4 | \bar{X}_5 | $\bar{1}_7$ | 6 |
| 12 | \bar{X}_{13} | 15 | 14 |
| 8 | \bar{X}_9 | 11 | 10 |

$$= \bar{A}\bar{B}D + \bar{A}B\bar{C}$$

$$J_4 = A\bar{B}$$

| | | | |
|----|----------------|-------------|-------------|
| 0 | 1 | 3 | $\bar{1}_2$ |
| 4 | \bar{X}_5 | \bar{X}_7 | 6 |
| 12 | \bar{X}_{13} | 15 | 14 |
| 8 | \bar{X}_9 | 11 | 10 |

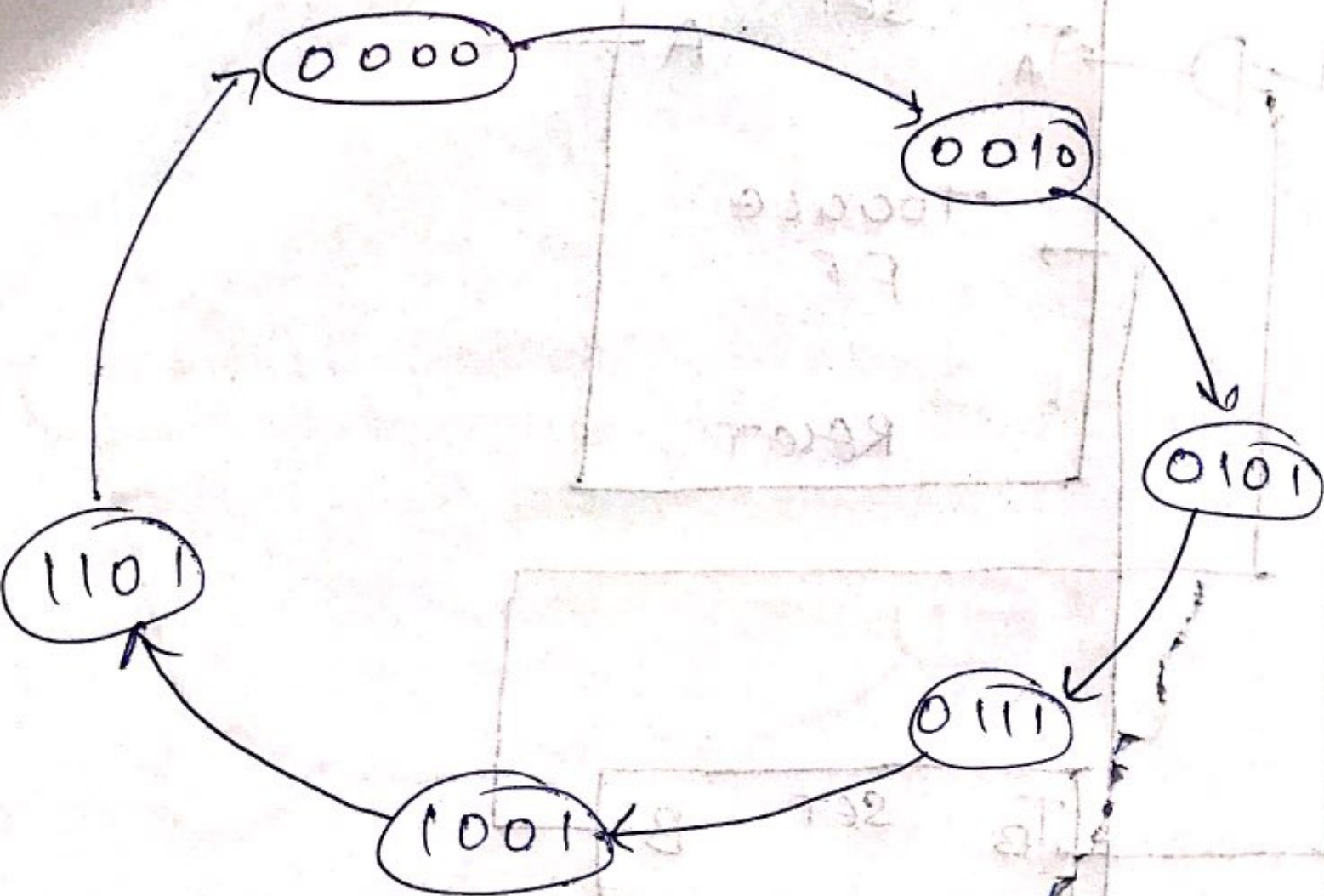
$$= \bar{A}\bar{B}C\bar{D}$$

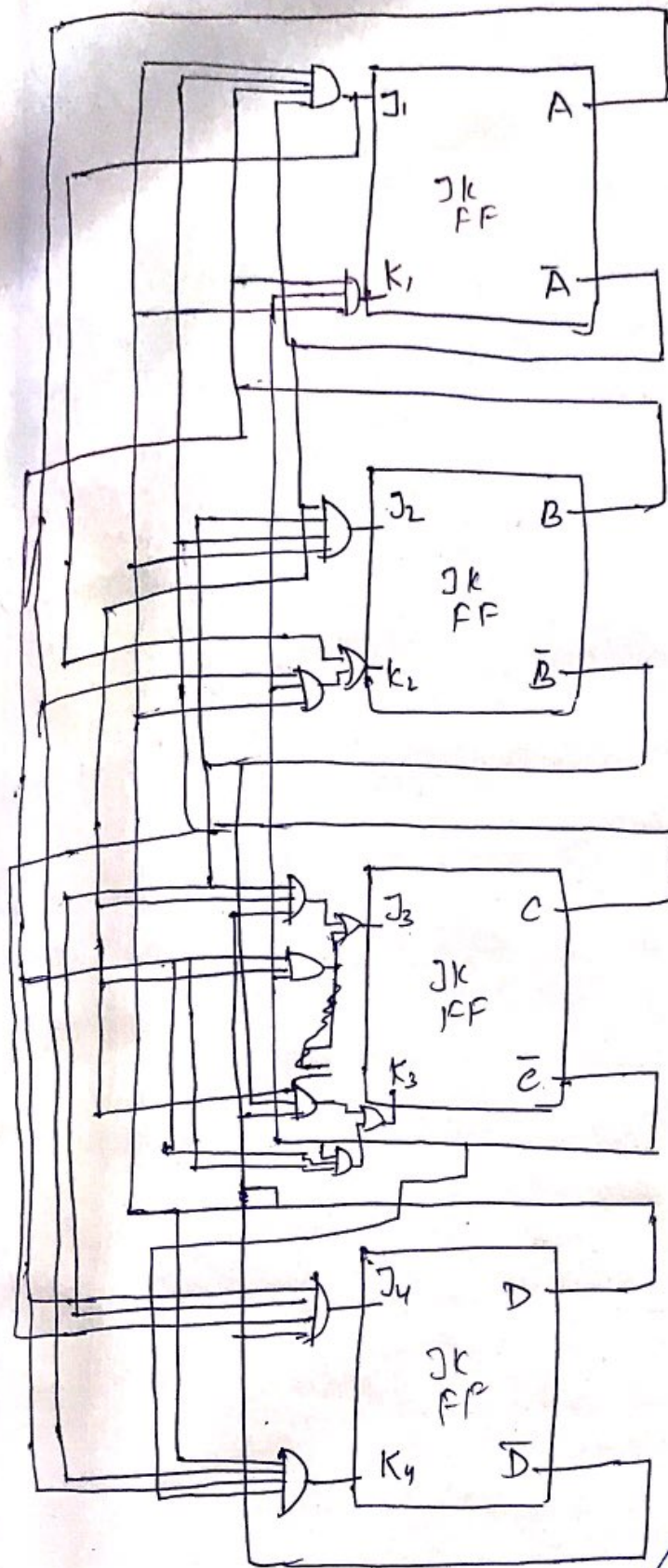
$$K_4 = A\bar{B}$$

| | | | |
|-------------|----------------|----|-------------|
| \bar{X}_0 | 1 | 3 | \bar{X}_2 |
| 4 | 5 | 7 | 6 |
| 12 | $\bar{1}_{13}$ | 15 | 14 |
| 8 | 9 | 11 | 10 |

$$AB\bar{C}D$$

STATE DIAGRAM





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Vasanth

