Department of Electrical and Computer Engineering

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Logic design (Fall 2021)

Quiz # 12

Name:_____ID:_____

1. (100%) Design a 3-bit counter in the sequence: (C, B, A) = 111, 101, 011, 110, 000, 010, (repeat) 111, …… / 111, 100, 101, 001, 000, 110, (repeat) 111, …… with D flip-flops and J-K flip-flops. Note that you just need to drive the Boolean equations for the input of each flip-flops.

   (a). (28%) Complete the following table.

   (b). (36%) Use D flip-flops.

   $C^+ =$

   $B^+ =$

   $A^+ =$

   (c). (36%) Use J-K flip-flops.

   $J_C =$

   $K_C =$

   $J_B =$

   $K_B =$

   $J_A =$

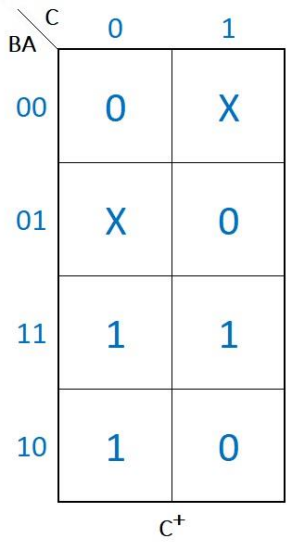
   $K_A =$

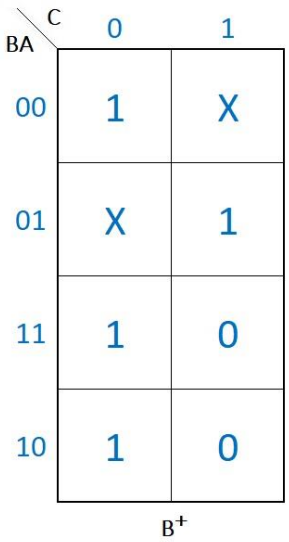
Ans:

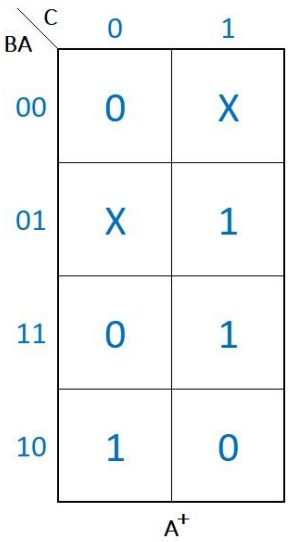
(a).

C	B	A	$C^+B^+A^+$	J_C	K_C	J_B	K_B	J_A	K_A
0	0	0	010	0	X	1	X	0	X
0	0	1	XXX	X	X	X	X	X	X
0	1	0	111	1	X	X	0	1	X
0	1	1	110	1	X	X	0	X	1
1	0	0	XXX	X	X	X	X	X	X
1	0	1	011	X	1	1	X	X	0
1	1	0	000	X	1	X	1	0	X
1	1	1	101	X	0	X	1	X	0

(b).







$C^+ = AB + BC'$

$B^+ = B' + C'$

$A^+ = AC + A'BC'$

(c).

BA \ C	0	1
00	0	X
01	X	X
11	1	X
10	1	X

J_C

BA \ C	0	1
00	X	X
01	X	1
11	X	0
10	X	1

K_C

BA \ C	0	1
00	1	X
01	X	1
11	X	X
10	X	X

J_B

BA \ C	0	1
00	X	X
01	X	X
11	0	1
10	0	1

K_B

BA \ C	0	1
00	0	X
01	X	X
11	X	X
10	1	0

J_A

BA \ C	0	1
00	X	X
01	X	0
11	1	0
10	X	X

K_A

$J_C = B$

$K_C = A' + B'$

$J_B = 1$

$K_B = C$

$J_A = BC'$

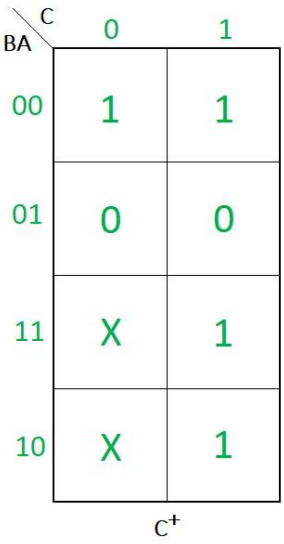
$K_A = C'$

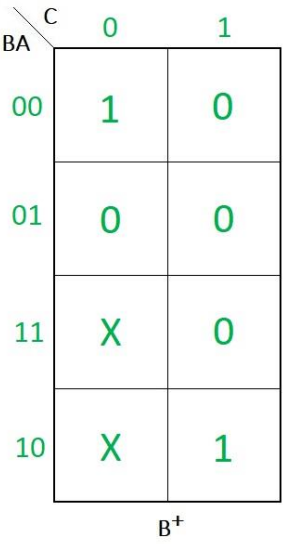
Ans:

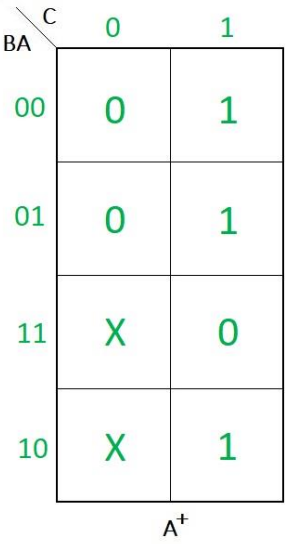
(a).

C	B	A	$C^+B^+A^+$	J_C	K_C	J_B	K_B	J_A	K_A
0	0	0	110	1	X	1	X	0	X
0	0	1	000	0	X	0	X	X	1
0	1	0	XXX	X	X	X	X	X	X
0	1	1	XXX	X	X	X	X	X	X
1	0	0	101	X	0	0	X	1	X
1	0	1	001	X	1	0	X	X	0
1	1	0	111	X	0	X	0	1	X
1	1	1	100	X	0	X	1	X	1

(b).







$C^+ = A' + B$

$B^+ = A'B + A'C'$

$A^+ = A'C + B'C$ or $A'B + B'C$

(c).

BA \ C	0	1
00	1	X
01	0	X
11	X	X
10	X	X

J_C

BA \ C	0	1
00	X	0
01	X	1
11	X	0
10	X	0

K_C

BA \ C	0	1
00	1	0
01	0	0
11	X	X
10	X	X

J_B

BA \ C	0	1
00	X	X
01	X	X
11	X	1
10	X	0

K_B

BA \ C	0	1
00	0	1
01	X	X
11	X	X
10	X	1

J_A

BA \ C	0	1
00	X	X
01	1	0
11	X	1
10	X	X

K_A

$J_C = A'$

$K_C = AB'$

$J_B = A'C'$

$K_B = A$

$J_A = C$

$K_A = B + C'$