Department of Electronics Engineering
National Chiao Tung University

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Logic design (2016 spring)

Quiz # 12

Name:_____ID:_____

Design a counter with 4 flip-flops (denoted as A, B, C and D) that can generate the following Boolean sequence. (ABCD) = 0000,1001,1000,0111,0110,0101,0100,0011,0010,0001,0000,…… (repeat). Note that you don't need to draw the circuit. You just need to derive the Boolean equations for the inputs of the four flip-flops.

(a) (40%) Design the counter with 4 D flip-flops. Just derive the minimum SOP for D_A, D_B, D_C and D_D

ABCD	$A^+B^+C^+D^+$
0000	1001
0001	0000
0010	0001
0011	0010
0100	0011
0101	0100
0110	0101
0111	0110
1000	0111
1001	1000
1010	XXXX
1011	XXXX
1100	XXXX
1101	XXXX
1110	XXXX
1111	XXXX

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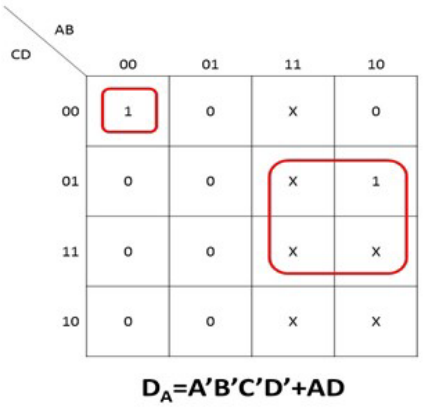
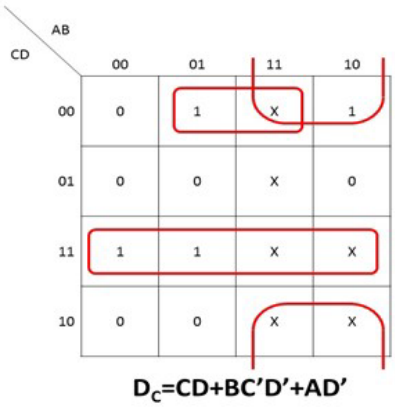
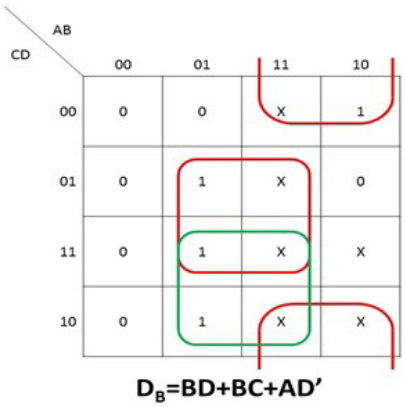


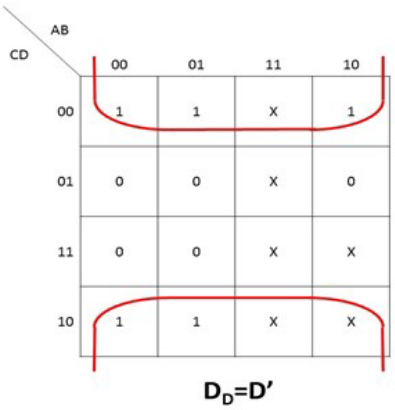
$D_A=A'B'C'D'+AD$



$D_C=CD+BC'D'+AD'$



$D_B=BD+BC+AD'$



$D_D=D'$

(b) (60%) Design the counter with 4 J-K flip-flops. Just derive the minimum SOP for J_A, K_A, J_B, K_B, J_C, K_C, J_D, K_D

ABCD	$A^+B^+C^+D^+$	J_A	K_A	J_B	K_B	J_C	K_C	J_D	K_D
0000	1001	1	X	0	X	0	X	1	X
0001	0000	0	X	0	X	0	X	X	1
0010	0001	0	X	0	X	X	1	1	X
0011	0010	0	X	0	X	X	0	X	1
0100	0011	0	X	X	1	1	X	1	X
0101	0100	0	X	X	0	0	X	X	1
0110	0101	0	X	X	0	X	1	1	X
0111	0110	0	X	X	0	X	0	X	1
1000	0111	X	1	1	X	1	X	1	X
1001	1000	X	0	0	X	0	X	X	1
1010	XXXX	X	X	X	X	X	X	X	X
1011	XXXX	X	X	X	X	X	X	X	X
1100	XXXX	X	X	X	X	X	X	X	X
1101	XXXX	X	X	X	X	X	X	X	X
1110	XXXX	X	X	X	X	X	X	X	X
1111	XXXX	X	X	X	X	X	X	X	X

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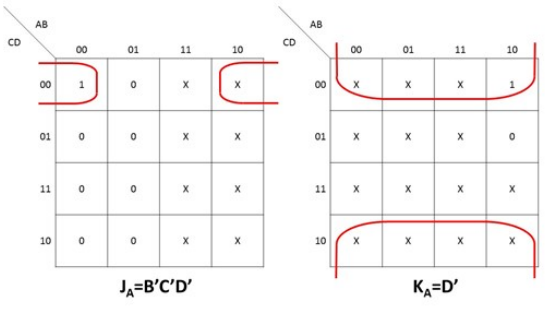
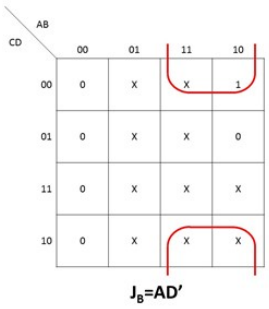
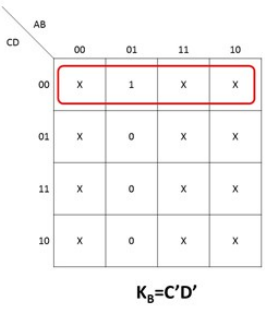


$J_A=B'C'D'$

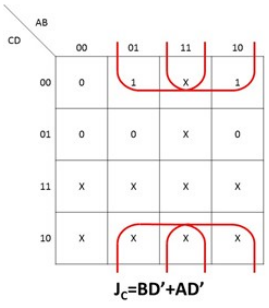
$K_A=D'$



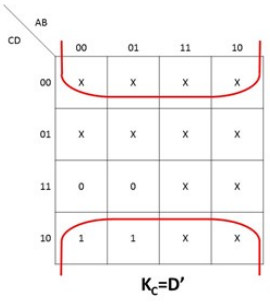
$J_B=AD'$



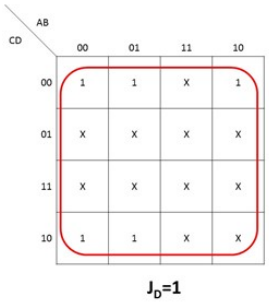
$K_B=C'D'$



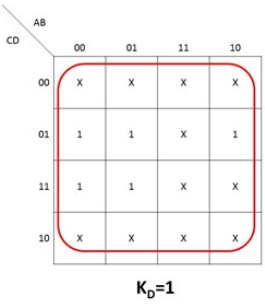
$J_C=BD'+AD'$



$K_C=D'$



$J_D=1$



$K_D=1$