University of California, San Diego

M.S. Exam: Logic Design (CSE140)

Spring 2014

NAME : _____

Question 1. [20 pts]

(a) **[10 pts]** Using Boolean algebra theorems, simplify F to a minimum sum-of-products.

- Your answer should have five terms exactly.
- Write all steps to answer. Do not write the name of Boolean algebra theorem.

$$F = (A + B' + C + E') \cdot (A + B' + D' + E) \cdot (B' + C' + D' + E')$$

(b) **[10 pts]** Find the minterm expansion of f.

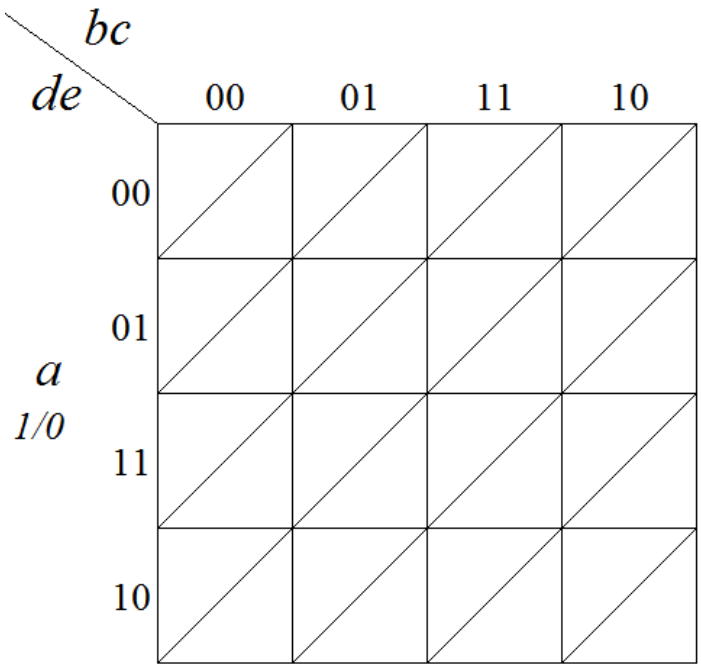
$$f(a, b, c, d) = a'b' + a'd + acd'$$

$$f = \sum m(\qquad)$$

Question 2. [20 pts]

$$F(a,b,c,d,e) = \sum m(0,3,4,5,6,7,8,12,13,14,16,21,23,24,29,31)$$

(a) **[10 pts]** Draw a Karnaugh map for F.



(b) **[5 pts]** Find the essential prime implicants (there are four essential prime implicants).

(c) **[5 pts]** Find all of the prime implicants (there are nine prime implicants).

Question 3. [20 pts]

(a) **[10 pts]** Implement F with three-level NAND gate circuit. Note that you have only two (2) two-input NAND gates and two (2) three-input NAND gates available for your implementation.

$$F(A, B, C, D) = \sum m(5, 10, 11, 12, 13)$$

(b) **[10 pts]** Implement F using one 4:1 MUX and one 2:1 MUX only. The output F should be the output of the 2:1 MUX. (d = don't care)

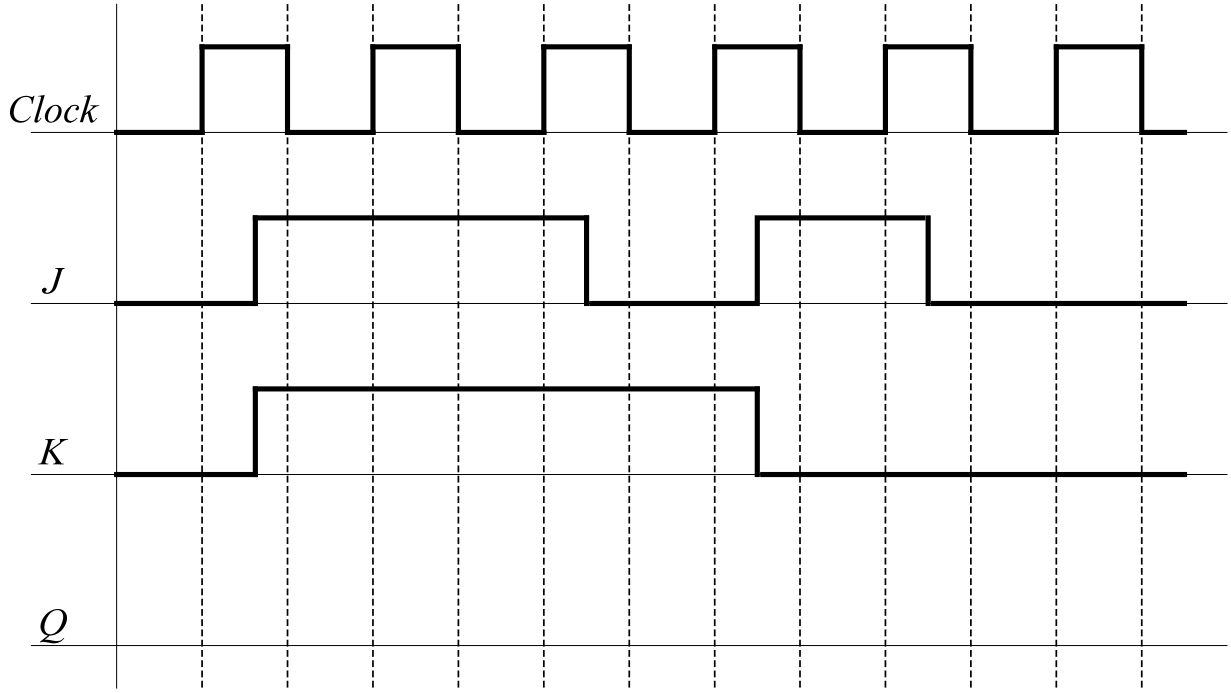
$$F(A, B, C, D) = \sum m(1, 3, 4, 5, 7, 9, 11, 14) + \sum d(8, 15)$$

Question 4. [10 pts]

(a) **[5 pts]** Fill the following truth table for J-K flip-flop.

J	*K*	*Q*	*Q+*
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

(b) **[5 pts]** Complete the following timing diagram for the J-K flip-flop.

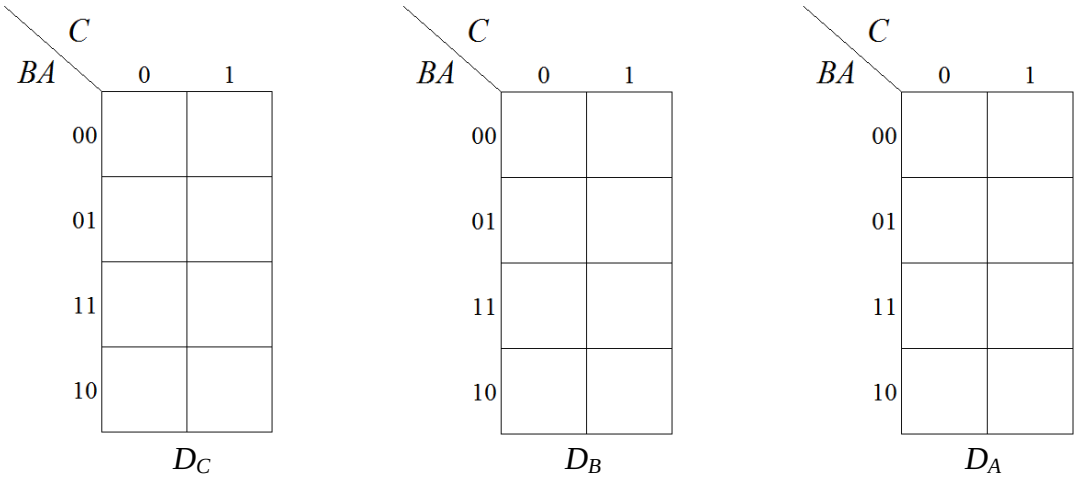


Question 5. [30 pts]
Design a 3-bit counter which counts 001, 011, 010, 110, 111, 101, 100, (repeat) 001, 011, ... Assume that the outputs of the flip-flops used in the counter are called (*C, B, A*).

(a) **[10 pts]** Fill the state transition table.

C	B	A	$C+$	$B+$	$A+$	J_C	K_C	J_B	K_B	J_A	K_A
0	0	0									
0	0	1									
0	1	0									
0	1	1									
1	0	0									
1	0	1									
1	1	0									
1	1	1									

(b) **[10 pts]** Implement the counter using D flip-flops in your circuit (sum-of-products form).

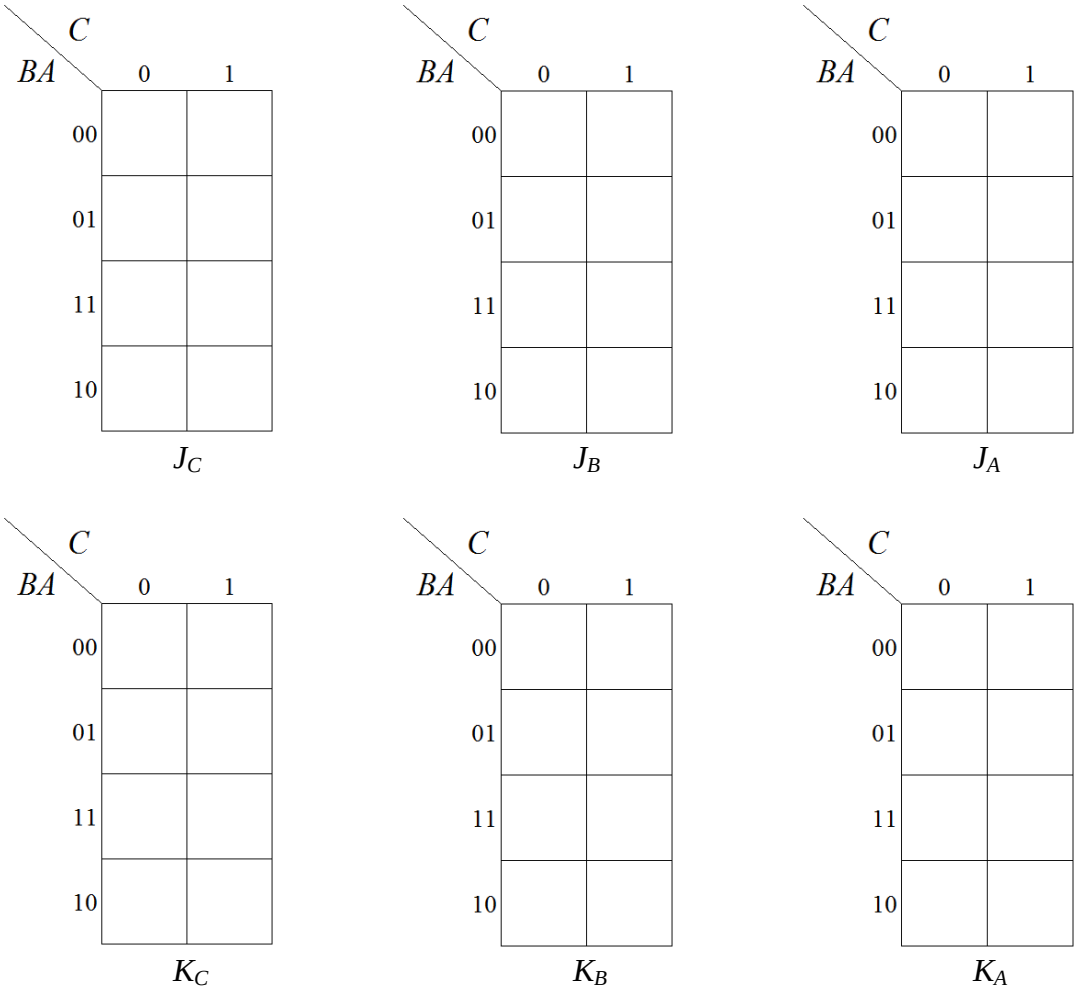


D_C = _____

D_B = _____

D_A = _____

(c) **[10 pts]** Implement the counter using J-K flip-flops in your circuit. (sum-of-products form)



J_C = _____

J_C = _____

J_B = _____

J_B = _____

J_A = _____

J_A = _____