

Introduction to Digital Computing

Homework 9 – Counter Design

Student's Name _____

Instructions:

- Show all work to receive full credit.
-

Design a synchronous counter that will display the following sequence and then repeat

0 → 2 → 6 → 8 → 7 → 5 → 3 → 1 (repeat)

Step 1: Write and sketch the sequence of the synchronous counter (3 points)

Step 2: Determine the number of flip flops that you need and the module number (3 points)

Step 3 and 4: Construct a truth table of the transition state with the PRESENT state and the NEXT state, and complete the J-K input for each flip flop using sequence diagram from Step 1.

Decimal	D(MSB)	PRESENT state			NEXT state			
		C	B	A (LSB)	D(MSB)	C	B	A (LSB)
0	0	0	0	0				
1	0	0	0	1				
2	0	0	1	0				
3	0	0	1	1				
4	0	1	0	0				
5	0	1	0	1				
6	0	1	1	0				
7	0	1	1	1				
8	1	0	0	0				
9	1	0	0	1				
10	1	0	1	0				
11	1	0	1	1				
12	1	1	0	0				
13	1	1	0	1				
14	1	1	1	0				
15	1	1	1	1				

Circuit excitation table for sequence 0 → 2 → 6 → 8 → 7 → 5 → 3 → 1

Decimal	J-K State							
	J _D	K _D	J _C	K _C	J _B	K _B	J _A	K _A
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Step 5: Create a k-map table for each J and K input and find the SOP equation of each.

<div><div>J_D</div><table><tr><td></td><td>$\overline{B}\overline{A}$</td><td>$\overline{B}A$</td><td>BA</td><td>$B\overline{A}$</td></tr><tr><td>$\overline{D}\overline{C}$</td><td></td><td></td><td></td><td></td></tr><tr><td>$\overline{D}C$</td><td></td><td></td><td></td><td></td></tr><tr><td>$D\overline{C}$</td><td></td><td></td><td></td><td></td></tr><tr><td>DC</td><td></td><td></td><td></td><td></td></tr></table><div>SOP :</div></div>		$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$	$\overline{D}\overline{C}$					$\overline{D}C$					$D\overline{C}$					DC					<div><div>J_C</div><table><tr><td></td><td>$\overline{B}\overline{A}$</td><td>$\overline{B}A$</td><td>BA</td><td>$B\overline{A}$</td></tr><tr><td>$\overline{D}\overline{C}$</td><td></td><td></td><td></td><td></td></tr><tr><td>$\overline{D}C$</td><td></td><td></td><td></td><td></td></tr><tr><td>$D\overline{C}$</td><td></td><td></td><td></td><td></td></tr><tr><td>DC</td><td></td><td></td><td></td><td></td></tr></table><div>SOP:</div></div>		$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$	$\overline{D}\overline{C}$					$\overline{D}C$					$D\overline{C}$					DC					<div><div>J_B</div><table><tr><td></td><td>$\overline{B}\overline{A}$</td><td>$\overline{B}A$</td><td>BA</td><td>$B\overline{A}$</td></tr><tr><td>$\overline{D}\overline{C}$</td><td></td><td></td><td></td><td></td></tr><tr><td>$\overline{D}C$</td><td></td><td></td><td></td><td></td></tr><tr><td>$D\overline{C}$</td><td></td><td></td><td></td><td></td></tr><tr><td>DC</td><td></td><td></td><td></td><td></td></tr></table><div>SOP:</div></div>		$\overline{B}\overline{A}$	$\overline{B}A$	BA	$B\overline{A}$	$\overline{D}\overline{C}$					$\overline{D}C$					$D\overline{C}$					DC				
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Step 6: Complete and sketch the counter circuit using the SOP equation found in **step 5**