

Logic design (2018 fall)

Quiz # 12

Name: _____ ID: _____

Design a 3-bit counter which counts in the sequence: (C,B,A) = 010, 000, 011, 101, 001, 100, 111, (repeat) 010, Note that you don't need to draw the circuit. You just need to drive the Boolean equations for the input of each flip-flops.

(a) (50%) Use D flip-flops.

CBA	$C^+B^+A^+$
000	
001	
010	
011	
100	
101	
110	
111	

C^+

		C	
		0	1
BA	00		
	01		
	11		
	10		

B^+

		C	
		0	1
BA	00		
	01		
	11		
	10		

A^+

		C	
		0	1
BA	00		
	01		
	11		
	10		

$C^+ =$

$B^+ =$

$A^+ =$

(b) (50%) Use S-R flip-flops.

S_C

		C	
		0	1
BA	00		
	01		
	11		
	10		

S_B

		C	
		0	1
BA	00		
	01		
	11		
	10		

S_A

		C	
		0	1
BA	00		
	01		
	11		
	10		

R_C

		C	
		0	1
BA	00		
	01		
	11		
	10		

R_B

		C	
		0	1
BA	00		
	01		
	11		
	10		

R_A

		C	
		0	1
BA	00		
	01		
	11		
	10		

$S_C =$

$R_C =$

$S_B =$

$R_B =$

$S_A =$

$R_A =$

Ans:

(010, 000, 011, 101, 001, 100, 111)

(a)

CBA	C ⁺ B ⁺ A ⁺
000	011
001	100
010	000
011	101
100	111
101	001
110	XXX
111	010

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

		B ⁺	
		C	
BA		0	1
00		1	1
01		0	0
11		0	1
10		0	X

		A ⁺	
		C	
BA		0	1
00		1	1
01		0	1
11		1	0
10		0	X

$$C^+ = C'A + CA'$$

$$B^+ = A'B' + CB$$

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

CBA	C ⁺ B ⁺ A ⁺
000	011
001	100
010	000
011	101
100	111
101	001
110	XXX
111	010

C⁺

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

B⁺

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

A⁺

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

(b)

S_C

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

S_B

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

S_A

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

R_C

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

R_B

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

R_A

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

$$S_C = AC'$$

$$R_C = AC$$

$$S_B = A'B'$$

$$R_B = BC'$$

$$S_A = A'B'$$

$$R_A = AB'C' + ABC$$