National Chiao Tung University
Dept. of Computer & Information Science
Intro. to Digital Systems, Spring 1998

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Handout #17
TA: Ze-Hong Li

Sample Solutions to Homework #5

Problems 1–12 are adopted from M. M. Mano and C. R. Kime, *Logic and Computer Design Fundamentals*, Prentice-Hall, Inc., 1997.

1. Problem 5–3 (pages 251).

   0010, 1001, 0100, 1010, 1101, 0110

2. Problem 5–5 (page 251).

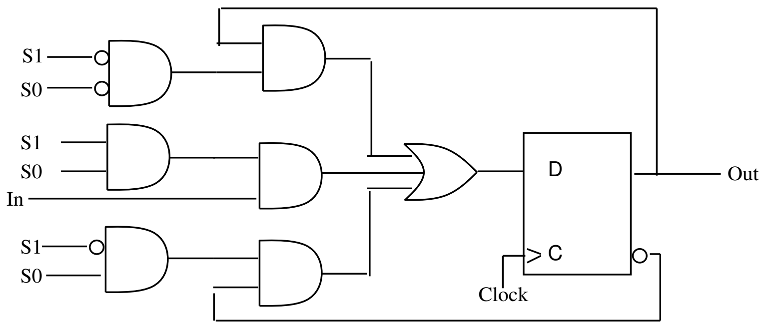
Time:	0	1	2	3	4
A	0101	0010	0001	0000	1000
B	0011	0001	0000	0000	0000
C	0	1	1	1	0

3. Problem 5–6 (page 251).

   The SO output to register B must be inverted and the initial carry must be set to 1, this forms the 2's complement of the contents of register B
   If $A < B$, the final value left in the carry flip-flop will be 0.
   If $A < B$, then the result will be in 2's complement form.

4. Problem 5–8 (page 252).

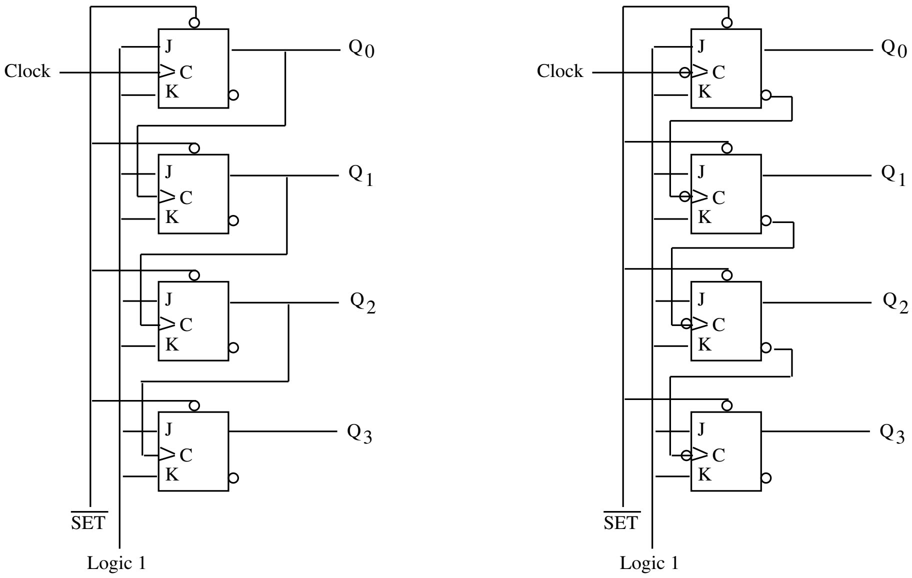
   The basic cell of the register is as follows:



5. Problem 5–13 (page 252).

   a) 6 b) 10

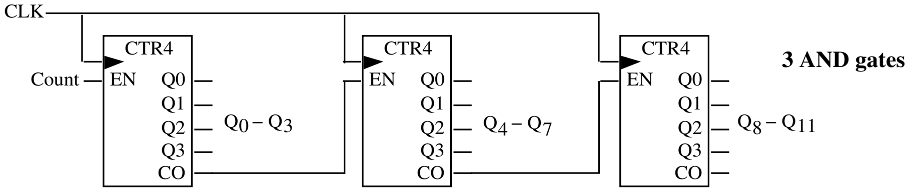
6. Problem 5–14 (page 252).



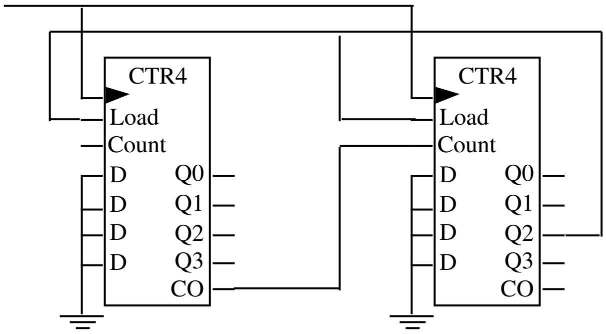
7. Problem 5–15 (page 252).

$$
\begin{aligned}
Q_0 &= \bar{Q}_0 E \\
Q_1 &= (Q_0\bar{Q}_1 + \bar{Q}_0 Q_1)E \\
Q_2 &= (Q_0 Q_1 \bar{Q}_2 + \bar{Q}_1 Q_2 + \bar{Q}_0 Q_2)E \\
Q_3 &= (\bar{Q}_2 Q_3 + \bar{Q}_1 Q_3 + \bar{Q}_0 Q_3 + Q_0 Q_1 Q_2 \bar{Q}_3)E
\end{aligned}
$$

8. Problem 5–17 (page 252).



9. Problem 5–21 (page 253).



10. Problem 5–24(b) (page 253).

Present state			Next State			FF Inputs					
A	B	C	A	B	C	J_A	K_A	J_B	K_B	J_C	K_C
0	0	0	0	0	1	0	X	0	X	1	X
0	0	1	0	1	0	0	X	1	X	X	1
0	1	0	0	1	1	0	X	X	0	1	X
0	1	1	1	0	0	1	X	X	1	X	1
1	0	0	0	0	0	X	1	0	X	0	X
0	0	0	0	0	1	0	X	0	X	1	X
0	0	1	0	1	0	0	X	1	X	X	1
0	1	0	0	1	1	0	X	X	0	1	X
0	1	1	1	0	0	1	X	X	1	X	1
1	0	0	1	0	1	X	0	0	X	1	X
1	0	1	1	1	0	X	0	1	X	X	1
1	1	0	0	0	0	X	1	X	1	0	X

$$
\begin{aligned}
J_A &= BC \\
K_A &= B \\
J_B &= C \\
K_B &= A + C \\
J_C &= \bar{A} + \bar{B} \\
K_C &= 1
\end{aligned}
$$

11. Problem 5–25 (page 253).

Present state			Next State			FF Inputs		
A	B	C	A	B	C	T_A	T_B	T_C
0	0	0	0	0	1	0	0	1
0	0	1	0	1	1	0	1	0
0	1	0	1	0	0	1	1	0
0	1	1	0	1	0	0	0	1
1	0	0	1	1	0	0	1	0
1	1	0	0	0	0	1	1	0

$$
\begin{aligned}
T_A &= B\bar{C} \\
T_B &= A + B\bar{C} + \bar{B}C \\
T_C &= BC + \bar{A}\bar{B}\bar{C}
\end{aligned}
$$

12. Problem 5–26 (page 253).

Present state				Next State				FF Inputs			
A	B	C	D	A	B	C	D	D_A	D_B	D_C	D_D
0	0	0	0	0	0	0	1	0	0	0	1
0	0	0	1	0	0	1	0	0	0	1	0
0	0	1	0	0	1	0	0	0	1	0	0
0	1	0	0	1	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0

$$
\begin{aligned}
D_A &= B \\
D_B &= C \\
D_C &= D \\
D_D &= \bar{A}\bar{B}\bar{C}\bar{D}
\end{aligned}
$$

13. (DIY Problem) For this problem, you are asked to design a problem set related to Chapter 5 of the text and give a sample solution to your problem set. Grading on this problem will be based upon the *quality* of the designed problem as well as the *correctness* of your sample solution.