UNIVERSITY OF CALIFORNIA, RIVERSIDE

Department of Computer Science and Engineering

CS/EE120B – Introduction to Embedded Systems

Midterm 1

Summer 2 August 6, 2002

16

Name: Solution Key **Student ID#:**

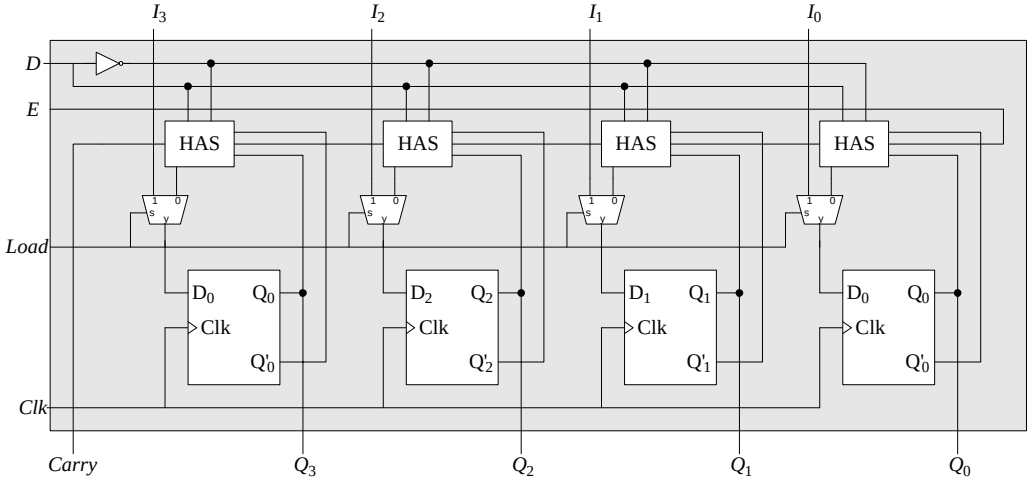
Please print legibly

(Numbers in parenthesis denote total possible points for question.)

1. Design a 4-bit up/down counter having the following operations using D flip-flops, HASs, and other necessary components. The control signals are *Load*, *E*, and *Down*. (4)

Load	*E*	*Down*	operation
0	0	×	no change
0	1	0	count up
0	1	1	count down
1	×	×	parallel load the input

Answer



2. Using a 4-bit up/down counter, design an up/down counter that counts as follows:

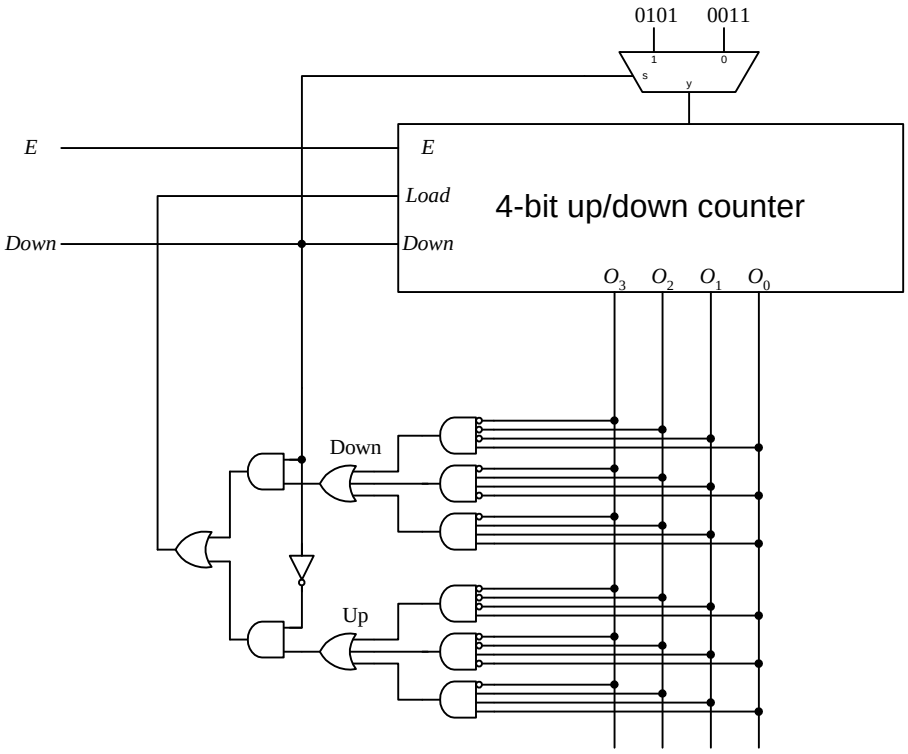
   - up: from 3 up to 7 and back to 3
   - down: from 5 down to 1 and back to 5

   When the signal *Down* is changed, and the count is not within range of that count sequence, then the next count should start from the first number of that count sequence (3 for up and 5 for down). For example, assume that it is currently counting down. If *Down* changes when the count reaches 1, the next count is set to 3. (4)

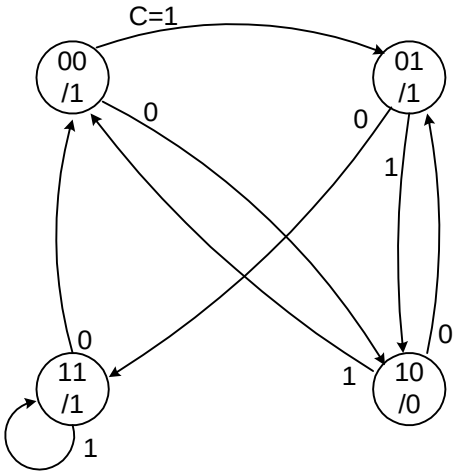
Answer

The *Load* signal is asserted as follows:

- down: *Down* and (count = 1 or count > 5)
- up: *Down'* and (count = 7 or count < 3)



3. Synthesize a FSM that realizes the following state diagram using a JK flip-flop for the most significant bit and a D flip-flop for the least significant bit. (4)



Answer

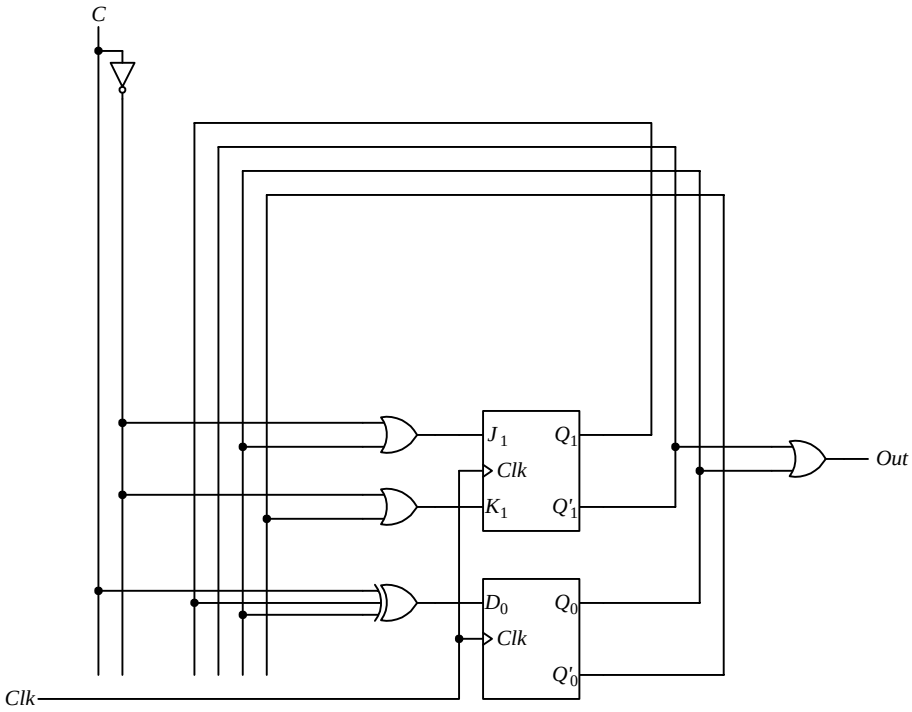
Next-state / Output table

	$Q_{1next}Q_{0next}$		
Q_1Q_0	C=0	C=1	Out
00	10	01	1
01	11	10	1
10	01	00	0
11	00	11	1

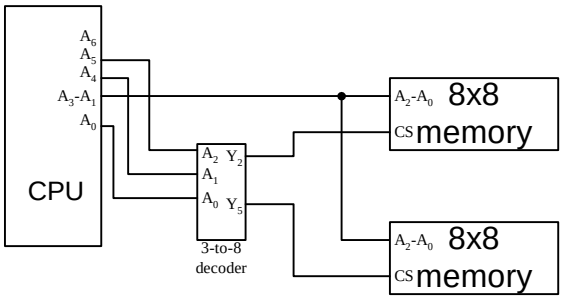
Implementation table

	$J_1\,K_1\,D_0$		
Q_1Q_0	C=0	C=1	Out
00	1×0	0×1	1
01	1×1	1×0	1
10	×11	×10	0
11	×10	×01	1

$J_1 = C' + Q_0$
$K_1 = C' + Q_0'$
$D_0 = C \oplus Q_1 \oplus Q_0$
$Out = Q_1' + Q_0$


C
J1
Clk
K1
Q1
Q'1
D0
Clk
Q0
Q'0
Out
Clk

4. Given the following memory circuit, determine all the possible addresses (in hex) to access locations 3 and 6 for both the top and bottom memory chip. (4)



Answer

Location	A_6	A_5	A_4	A_3	A_2	A_1	A_0	Hex
Top 3	0	0	1	0	1	1	0	16
	1	0	1	0	1	1	0	56
Top 6	0	0	1	1	1	0	0	1C
	1	0	1	1	1	0	0	5C
Bottom 3	0	1	0	0	1	1	1	27
	1	1	0	0	1	1	1	67
Bottom 6	0	1	0	1	1	0	1	2D
	1	1	0	1	1	0	1	6D