

# CMPEN 271 – Fall 2012

Exam 2

Name:

PSU ID:

D	Q+	T	Q+	S	R	Q+	J	K	Q+
0	0	0	Q	0	0	Q	0	0	Q
0	0	0	Q	0	1	0	0	1	0
1	1	1	Q'	1	0	1	1	0	1
				1	1	x	1	1	Q'

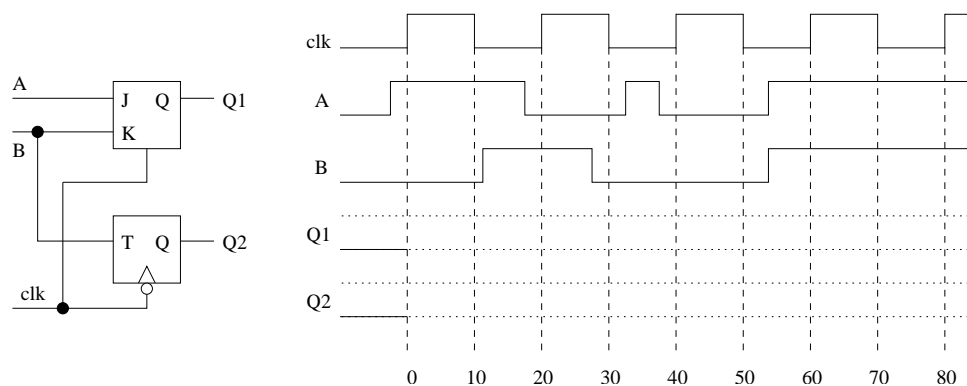
- (1 pt.) Assuming a word size of 5 bits, interpret 11010 as a 2's complement number.  
a) -24      b) -12      c) -6      d) -2      e) None of the above.
- (1 pt.) Assuming a word size of 4 bits, determine the 2's complement representation of -5.  
a) 1011      b) 1101      c) 1100      d) 1001      e) None of the above.
- (2 pt.) How many AND gates are in a 4:16 decoder?  
a) 4      b) 8      c) 16      d) 32      e) None of the above.
- (2 pt.) How many inputs do the AND gates in a 16:1 mux have?  
a) 2      b) 4      c) 8      d) 16      e) None of the above.
- (1 pt.) How many 4:1 muxes are needed to construct a 8x4x1 mux?  
a) 4      b) 8      c) 12      d) 32      e) None of the above.
- (2 pt.) How many 2:1 muxes are in an 8-bit register?  
a) 2      b) 3      c) 4      d) 8      e) 64
- (1 pt.) How many address lines does a 256kx32 RAM have?  
a) 32      b) 19      c) 18      d) 16      e) 15

Questions 8-10 concern the construction of a bit-slice of a comparator. The questions will ask you to complete the entries in the truth table below denoted by  $a$ ,  $b$ , and  $c$ .

$G_{in}$	$L_{in}$	$E_{in}$	$x$	$y$	$G_{out}$	$L_{out}$	$E_{out}$
0	0	0	1	0	$a$		
0	0	1	1	0		$b$	
1	0	1	1	0			$c$

8. (1 pt.) What is the value of  $a$ ?  
a) 0                      b) 1                      c) x
9. (1 pt.) What is the value of  $b$ ?  
a) 0                      b) 1                      c) x
10. (1 pt.) What is the value of  $c$ ?  
a) 0                      b) 1                      c) x

For questions 11-14 use the following figure



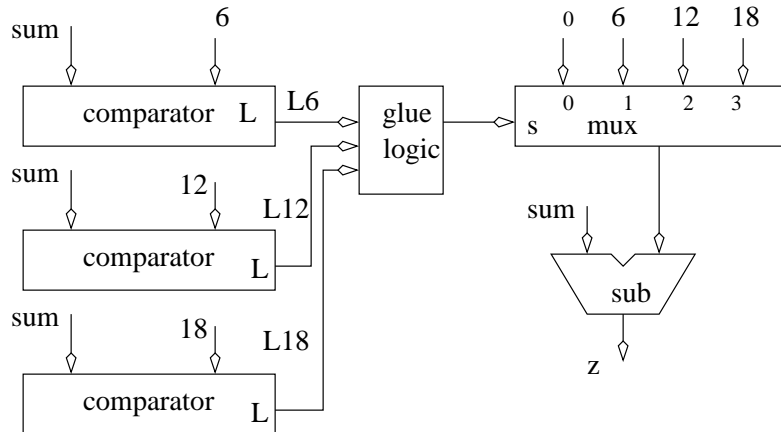
11. (1 pt.) What is the value of Q1 at time 45  
a) 0                      b) 1                      c) toggling
12. (1 pt.) What is the value of Q1 at time 65  
a) 0                      b) 1                      c) toggling
13. (1 pt.) What is the value of Q2 at time 25  
a) 0                      b) 1                      c) toggling
14. (1 pt.) What is the value of Q2 at time 75  
a) 0                      b) 1                      c) toggling

You have a digital design which calls for a circuit which performs the following task (written as a C if/then statement). You have decided on the architecture. Its your job to design to complete the truth table for the glue-logic box (only an arbitrary portion of the complete truth table is shown). I would recommend drawing a number line and putting the values of L6, L12, and L18 on it.

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if      (sum < 6)  z = sum
else if (sum < 12) z = sum-6
else if (sum < 18) z = sum-12
else      z = sum-18

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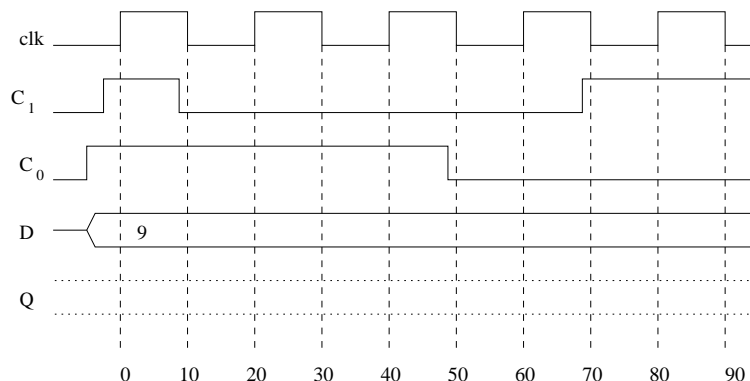


L6	L12	L18	select
0	0	0	a
0	1	1	b
1	0	1	c

15. **(1 pt.)**What is the (decimal) value of a in the truth table?
  - a) 0
  - b) 1
  - c) 2
  - d) 3
  - e) x
16. **(1 pt.)**What is the (decimal) value of b in the truth table?
  - a) 0
  - b) 1
  - c) 2
  - d) 3
  - e) x
17. **(1 pt.)**What is the (decimal) value of c in the truth table?
  - a) 0
  - b) 1
  - c) 2
  - d) 3
  - e) x

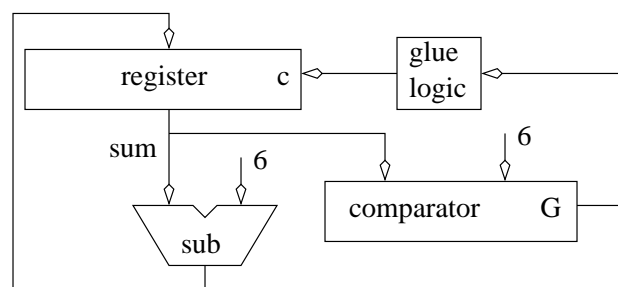
For questions 18,19 assume that a 4-bit (circular) shift register has the following truth table. Complete the timing diagram below.

clk	$C_1C_0$	D	$Q^+$
0,1,↓	xx	x	Q
↑	00	x	Q
↑	01	x	$Q \gg 1$ (CSR)
↑	10	x	$Q \ll 1$ (CSL)
↑	11	D	D



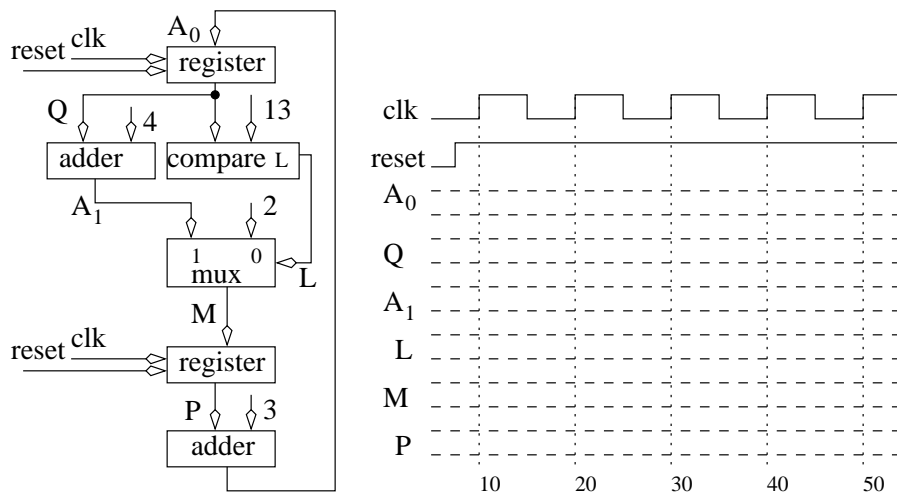
18. (1 pt.) What is the value of  $Q$  at time 55?
- a) 0110    b) 0010    c) 0100    d) 1110    e) none of the above
19. (1 pt.) What is the value of  $Q$  at time 90?
- a) 0001    b) 1100    c) 0100    d) 1110    e) none of the above
20. (2 pt.) You have a digital design which calls for a circuit which performs the following task. You have decided on the architecture shown to the right. Its your job to design the contents of the glue-logic box. Note, a register holds its value when the control input is 0 and loads its input when the control input is 1.

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while (sum > 6) sum -= 6;
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- a)  $c=0$     b)  $c=1$     c)  $c=G$     d)  $c=G'$     e) none of the above.

For problems 21-25 use the following figure and timing diagram. You should assume that all the devices process 5-bits data values.



21. (2 pt.) What is the value of  $P$  at time 15?  
a) 0      b) 3      c) 4      d) 6      e) 11
22. (2 pt.) What is the value of  $A_0$  at time 25?  
a) 3      b) 5      c) 7      d) 8      e) 10
23. (1 pt.) What is the value of  $A_1$  at time 35?  
a) 8      b) 11      c) 14      d) 15      e) 18
24. (1 pt.) What is the value of  $Q$  at time 45?  
a) 5      b) 7      c) 11      d) 13      e) 14
25. (1 pt.) What is the value of  $M$  at time 55?  
a) 2      b) 5      c) 7      d) 8      e) 9