CMPEN 270 – Fall 2015

Exam 2

Name: PSU ID:

1. **(3 pts.)** Assuming a word size of 5 bits, interpret 10110 as a 2's complement number.

   a) -9 b) -10 c) -5 d) 22 e) None of the above.

2. **(3 pts.)** Assuming a word size of 5 bits, determine the 2's complement representation of -9.

   a) 11011 b) 10111 c) 10110 d) 11001 e) None of the above.

3. **(4 pts.)** How many inputs do the AND gates in a 32:1 mux have?

   a) 5 b) 6 c) 31 d) 32 e) None of the above.

4. **(3 pts.)** How many 2:1 muxes does it take to build a 32:1 mux?

   a) 3 b) 7 c) 15 d) 31 e) None of the above.

   Questions 5-7 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	1	1	1	a		
1	0	0	0	1		b	
1	0	1	1	0			c

5. **(2 pts.)**What is the value of a?

   a) 0 b) 1 c) x

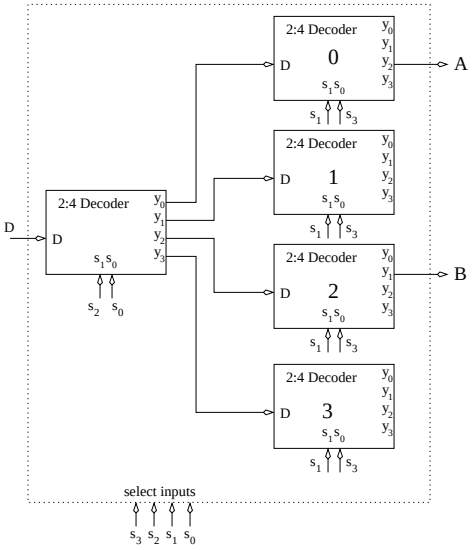
6. **(2 pts.)**What is the value of b?

   a) 0 b) 1 c) x

7. **(2 pts.)**What is the value of c?

   a) 0 b) 1 c) x

You are given the following 4:16 decoder built from 2:4 decoders. Unfortunately, the student who built it wired the select lines in a most unusual fashion. Its your job to label each output with the index which selects it. Most of the outputs have been omitted for clarity.



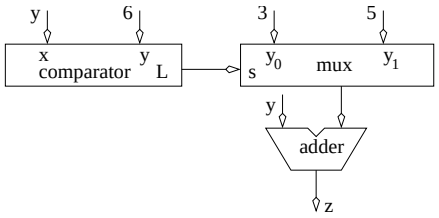
8. **(3 pts.)** What is the value of the output labeled A?

   a) y_1 b) y_2 c) y_4 d) y_8 e) None of the above

9. **(3 pts.)** What is the value of the output labeled B?

   a) y_1 b) y_6 c) y_9 d) y_{12} e) None of the above

10. **(5 pts.)** Which line of pseudo-code is equivlent to the following piece of hardware. Y is a 4-bit binary number.



   a) `if (5 < Y) then Z = X+3 else Z = Y+5;`

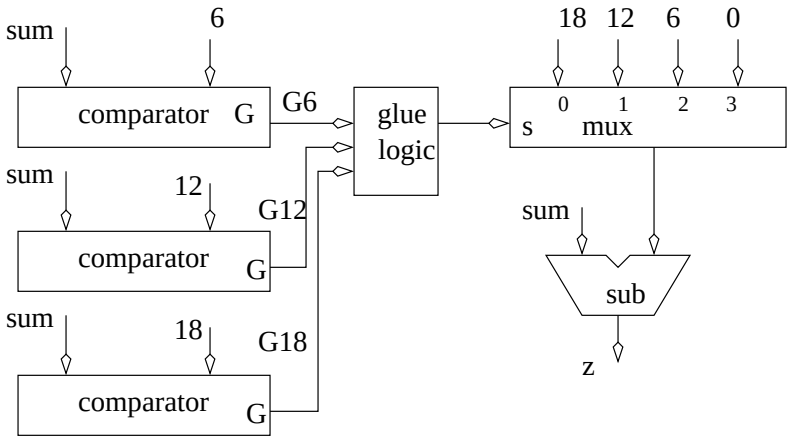
   b) `if (6 < Y) then Z = Y+3 else Z = Y+5;`

   c) `if (6 > Y) then Z = X+3 else Z = Y+5;`

   d) `if (5 > Y) then Z = Y+3 else Z = Y+5;`

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 the glue-logic box (only an arbitrary portion of the complete truth table is shown).

```
if      (sum > 18) z = sum-18
else if (sum > 12) z = sum-12
else if (sum > 6)  z = sum-6
else               z = sum
```



G6	G12	G18	select
0	0	0	a
1	1	0	b
1	0	1	c

11. **(3 pts.)**What is the (decimal) value of a in the truth table?
    a) 0 b) 1 c) 2 d) 3 e) x

12. **(3 pts.)**What is the (decimal) value of b in the truth table?
    a) 0 b) 1 c) 2 d) 3 e) x

13. **(3 pts.)**What is the (decimal) value of c in the truth table?
    a) 0 b) 1 c) 2 d) 3 e) x

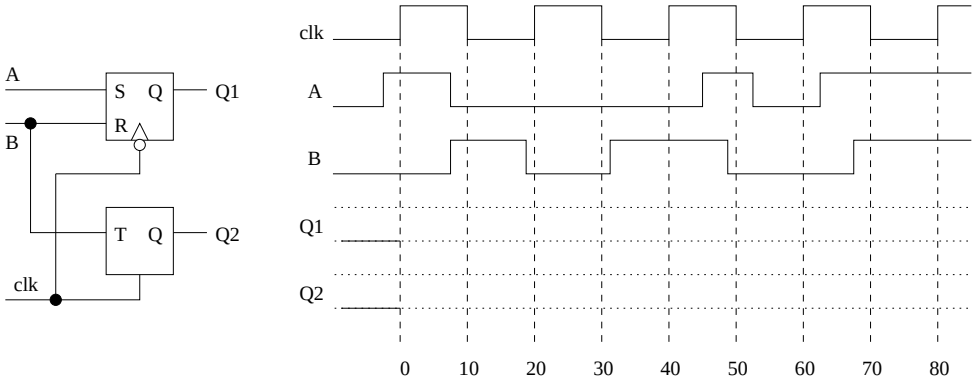
D	Q+
0	0
1	1

T	Q+
0	Q
1	Q'

S	R	Q+
0	0	Q
0	1	0
1	0	1
1	1	x

J	K	Q+
0	0	Q
0	1	0
1	0	1
1	1	Q'

For questions 14-19 use the following figure. Assume that initial value of $\overline{Q}$ is 0 (as shown in the figure), and that the outputs, after a period of rapid toggling, end-up at 0.



14. **(3 pts.)** What is the value of Q1 at time 25

    a) 0 b) 1 c) toggling d) unknown

15. **(2 pts.)** What is the value of Q1 at time 35

    a) 0 b) 1 c) toggling d) unknown

16. **(1 pt.)** What is the value of Q1 at time 65

    a) 0 b) 1 c) toggling d) unknown

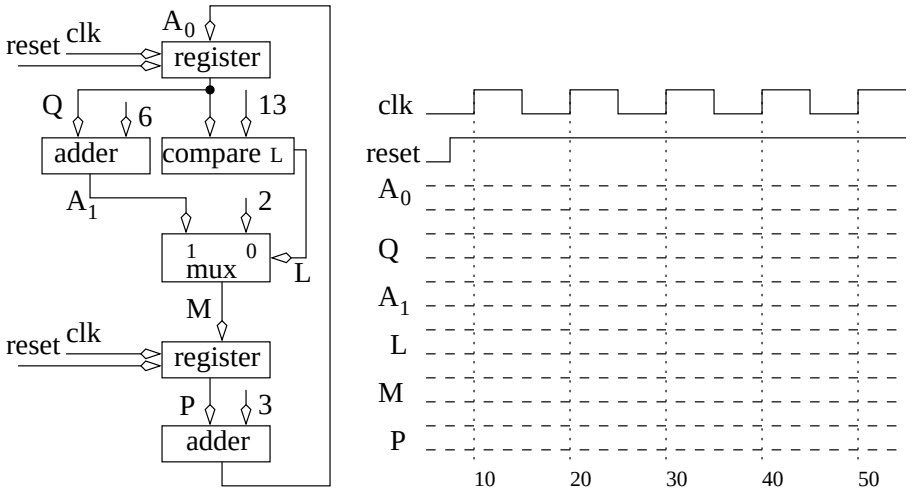
17. **(2 pts.)** What is the value of Q2 at time 25

    a) 0 b) 1 c) toggling d) unknown

18. **(1 pts.)** What is the value of Q2 at time 45

    a) 0 b) 1 c) toggling d) unknown

For problems 19-23 use the following figure and timing diagram. You should assume that all the devices process 5-bits data values.



19. **(5 pts.)**What is the value of Q at time 15?

    a) 0 b) 3 c) 6 d) 9 e) none of the above

20. **(4 pts.)**What is the value of P at time 25?

    a) 2 b) 9 c) 12 d) 15 e) none of the above

21. **(3 pts.)**What is the value of A_1 at time 35?

    a) 5 b) 9 c) 12 d) 18 e) none of the above

22. **(2 pts.)**What is the value of M at time 45?

    a) 2 b) 5 c) 11 d) 12 e) none of the above

23. **(1 pts.)**What is the value of Q at time 55?

    a) 5 b) 11 c) 12 d) 14 e) none of the above