ECE 124 digital circuits and systems
Assignment #4

Q1: Convert the following unsigned numbers to decimal:

(a) $(2314)_5$

(b) $(498)_{12}$

(c) $(0111011110)_2$

(d) $(1011100111)_2$

(e) $(3742)_8$.

(f) $(A26E)_{16}$.

(g) $(F0F0)_{16}$.

Q2: Express the following unsigned numbers in decimal:

(a) $(10110.0101)_2$

(b) $(16.12)_{16}$

(c) $(26.24)_7$

Q3: Determine the base of the unsigned numbers in each of the following cases for the operations to be true:

(a) $14 \div 2 = 5$

(b) $54 \div 4 = 13$

(c) $24 + 17 = 40$

Q4: Convert each of the following unsigned binary numbers to octal and hexidecimal:

(a) $(0111011110)_2$

(b) $(1011100111)_2$

Q5: Determine the decimal values of the following 2s complement numbers:

(a) $(0111011110)_2$

(b) $(1011100111)_2$

(c) $(1111111110)_2$

Q6: Convert the decimal numbers 73, 1906, -95 and -1630 into signed 12-bit binary numbers assuming 2s complement representation.

Q7: Perform the following operations involving eight bit 2s complement numbers. Indicate whether or not overflow occurs. Check your answers by converting the numbers to decimal.

00110110	01110101	11011111
+ 01000101	+ 11011110	+ 10111000

00110110	01110101	11010011
- 00101011	- 11010110	- 11101100

Q8: Prove the validity of finding a 2s complement of a number by scanning the number from right to left, copying all the 0s and the first 1 and then flipping all the remaining bits.

Q9: Prove that the carry out signal, c_k, from the $k-1$ position of an adder can be generated as $c_k = x_k \oplus y_k \oplus s_k$ where x_k and y_k are the inputs and s_k is the sum bit.

Q10: Determine the number of gates required to implement an n-bit carry-lookahead adder. Use AND, OR and XOR gates with any number of inputs.

Q11: Design a simple circuit that determines how many bits are equal to 1 in a 3-bit unsigned number.

Q12: Repeat question 11 assuming a 6-bit unsigned number.

Q13: Design a simple circuit that can add 3, 4-bit unsigned numbers. You may use only 4-bit adders and any other required logic gates.

Q14: An incrementer circuit is a circuit that adds one to a binary number. Design a 4-bit incrementer circuit using only half-adder circuits.

Q15: Design a simple circuit that outputs the 2s complement if an n-input binary number. Show that the circuit can be constructed with only XOR and OR gates.

Q16: Consider the 3-input logic function Y shown in Figure 1 build from CMOS transistors. Complete the circuit and then determine the logic function for Y.

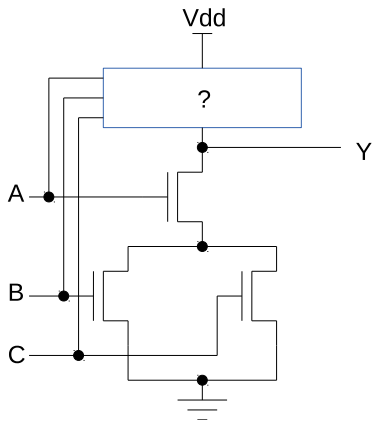

Figure 1: Figure for problem 16.