SC1005 Digital Logic Tutorial 3

Digital arithmetic

1. Perform the following unsigned binary addition and subtraction.

a.
$$\begin{array}{r} 1100110 \\ +\,1111001 \\ \hline 11011111 \end{array}$$

b.
$$\begin{array}{r} 11100011 \\ -\,01011101 \\ \hline 10000110 \end{array}$$

2. Perform the following two's complement additions. Clearly indicate whether or not an overflow occurs.

a.
$$\begin{array}{r} 11010100 \\ +\,11101011 \\ \hline 110111111 \end{array}$$
No $= 10111111$

b.
$$\begin{array}{r} 10111111 \\ +\,11011111 \\ \hline 110011110 \end{array}$$
No $= 1001110$

c.
$$\begin{array}{r} 01011101 \\ +\,00110001 \\ \hline 10001110 \end{array}$$
Yes

d.
$$\begin{array}{r} 01100001 \\ +\,00011111 \\ \hline 10000000 \end{array}$$
Yes

3. Perform the following two's complement subtractions. Clearly indicate whether or not an overflow occurs. Check by converting to decimal values.

a.
$$\begin{array}{r} 00110110 \\ -\,01000101 \\ \hline 11110001 \end{array}$$
No $54 - 69 = -15$

b.
$$\begin{array}{r} 01110101 \\ -\,11010110 \\ \hline 10011111 \end{array}$$
Yes $\Rightarrow -96$ $117 + 42 = 159$

c.
$$\begin{array}{r} 11010111 \\ -\,11101100 \\ \hline 11101011 \end{array}$$
No $-41 - -20 = -21$

d.
$$\begin{array}{r} 10000011 \\ -\,10001111 \\ \hline 11110100 \end{array}$$
No $-125 - -113 = -12$

4. Perform the following unsigned binary multiplications. Verify with decimal values.

a.
$$\begin{array}{r} 110101 \\ \times\quad 1110 \\ \hline \end{array}$$
$53 \times 14 = 742$

b.
$$\begin{array}{r} 010110 \\ \times\quad 1101 \\ \hline \end{array}$$
$22 \times 13 = 286$

5. Perform the following signed 2's complement binary multiplications. Verify with decimal values.

a.
$$\begin{array}{r} 110101 \\ \times\quad 1110 \\ \hline \end{array}$$
$-11 \times -2 = 22$

b.
$$\begin{array}{r} 010110 \\ \times\quad 1101 \\ \hline \end{array}$$
$22 \times -3 = -66$

Answers

1.

a. 11011111
b. 10000110

2.

a. 10111111 (no overflow)
b. 10011110 (no overflow)
c. 10001110 (overflow)
d. 10000000 (overflow)

3.

a. 11110001 (no overflow)
b. 10011111 (overflow)
c. 11101011 (no overflow)
d. 11110100 (no overflow)

4.

a. 1011100110
b. 100011110

5.

a. 000010110
b. 110111110