Homework 1

1. What are the largest and smallest unsigned numbers that can be expressed with 10 bits?

Unsigned numbers range: $0 \sim 2^n - 1$ where n is number of beats, therefore the largest unsigned number equal to $2^{10} - 1 = 1024 - 1 = 1023$, and smallest unsigned number is 0 (00 0000 0000)

b) same question but for signed.

Signed number range $-2^{n-1} \sim +2^{n-1} - 1$

$-2^{10-1} - 1 \sim 2^{10-1} - 1$

$-2^9 - 1 \sim 2^9 - 1$

$-512 - 1 \sim 512 - 1$

$-511 \sim 512$

or if formula

$-2^{n-1} \sim 2^{n-1} - 1$

$-512 \sim 511$

2. Convert hex number F9A5 to binary and then from binary to octal.

F	9	A	5	
1111	1001	1010	0101	binary
1	7	4	6	4	5	

$(1\ 7\ 4\ 6\ 4\ 5)_8$

3. Convert decimal 39,375 to binary and hex

First take whole number

		q	r
39	2 =	19	1
19	2 =	9	1
9	2 =	4	1
4	2 =	2	0
2	2 =	1	0
1	2 =	0	1

$(100111)_2$

take fraction

$0,375 \cdot 2 = 0,75$

$0,75 \cdot 2 = 1,50$

$0,50 \cdot 2 = 1,00$

$(.011)_2$

$(39,375)_{10} = (100111.011)_2$

b) to hex

39	16 =	2	7
7	16 =	0	7

$(77)_{16}$

$0,375 \cdot 16 = 6$

$(.6)_{16}$

$(39,375)_{10} = (77.6)_{16}$

4. Express following fraction numbers in dec

$(11010.1001)_2$

$2^4\ 2^3\ 2^2\ 2^1\ 2^0$ | $2^{-1}\ 2^{-2}\ 2^{-3}\ 2^{-4}$

1 1 0 1 0 | 1 0 0 1

16 + 8 + 2 | 0,5 + 0,0625

26 | 0,5625

$(26,5625)_{10}$

b) $(18,5)_{16} = (24.031)_{10}$

$16^1\ 16^0$ | 16^{-1}

1 8 | 5

16 + 8 | 5×0.0625

24 | 0,31

c) $(37,24)_8 = (31,3125)_{10}$

$3\cdot8^1 + 7\cdot8^0$ | $2\cdot8^{-1} + 4\cdot8^{-2}$

$24 + 7$ | $2\cdot\frac{1}{8} + 4\cdot\frac{1}{8^2}$

31 | 0,25 + 0,0625

31 + 0,3125

5. Add and multiply without converting to de

$$\begin{array}{r} 1101 \\ +\ 111 \\ \hline 10100 \end{array}$$

$$\begin{array}{r} 1101 \\ \times\ 111 \\ \hline 1101 \\ 1101 \\ 1101 \\ \hline 1011011 \end{array}$$

6) Obtain 1's, 2's complement of following numbers:

a) 1 0 1 0 1 0 1 1

0 1 0 1 0 1 0 0 1's complement

0 1 0 1 0 1 0 0 +1 2's complement

b) 0 1 0 0 1 1 1 0

1 0 1 1 0 0 0 1

+1

1 0 1 1 0 0 1 0

e) 1 0 0 0 0 0 0 0 0

1 1 1 1 1 1 1 1

+1

1 ④ 1=0

not count → 1 0 0 0 0 0 0 0 0

7. Convert decimal to binary

+54 64 32 16 8 4 2 1

0 1 1 0 1 1 0

1 0 0 1 0 0 1 1's

-54 1 0 0 1 0 1 0 +1 2's

-64 8

54

+25 0 1 1 0 0 1

1 0 0 1 1 0 1's

-25 1 0 0 1 1 1 +1 2's

-32 4 2 1

+54 0 1 1 0 1 1 0

+25 0 1 1 0 0 1

79 1 0 0 1 1 1 1

$(+54) + (-25)$

	64	32	16	8	4	2	1
+54	0	1	1	0	1	1	0
+(-25)	1	1	0	0	1	1	1
1	0	0	1	1	1	0	1

$1 \oplus 1 = 0$

$(-54) + (+25)$

−54	1	0	0	1	0	1	0
+							
+25	0	0	1	1	0	0	1
"							
−29	1	1	0	0	0	1	1

$-54 + (-25)$

−54	1	0	0	1	0	1	0
+							
−25	1	1	0	0	1	1	1
"							
−79	1	0	1	1	0	0	1

8. Convert decimal 256 and 325 to BCD code, and perform their addition using BCD codes

256 - each digit as 4 bits

0010 0101 0110

325

0011 0010 0101

0101 0111 1011

5 7 11 > 9 add 6 = 0110

0110

5 7 0001 0001

1 1

9. Convert characters 8Ce3 to ASCII codes. Append an odd parity bit to each letter at the left.

Column first &

	b7	b6	b5	b4	b3	b2	b1
parity bit odd →	0	0	1	1	1	0	0
		C					
	0	1	0	0	0	0	1
		e					
	1	1	1	0	0	1	0
		3					
	1	0	1	1	0	0	1

10. string in Ascii represent in hex, left-most is parity bit. Remaining bits are ASCI

a) Convert into bit and decode

		parity bit (128) 64 32 16	8 4 2 1			
4A	=	0 1 0 0	1 0 1 0	= 74 =	j	= odd
EF	=	1 1 1 0	1 1 1 1	= 111 =	o	= odd
68	=	0 1 1 0	1 0 0 0	= 104 =	h	= odd
6E	=	0 1 1 0	1 1 1 0	= 110 =	n	= odd
20	=	0 0 1 0	0 0 0 0	= 32 =	␣	= odd
C4	=	1 1 0 0	0 1 0 0	= 68 =	D	= odd
EF	=	1 1 1 0	1 1 1 1	= 111 =	o	= odd
E5	=	1 1 1 0	0 1 0 1	= 101 =	e	= odd

b) determine parity used: odd/even