Q1: Convert 10101101.10110 into Octal, Hexadecimal and Decimal.

$(10101101.10110)_2 = (010\ 101\ 101.101\ 100)_2$
$= (\ 2\ \ 5\ \ 5\ .\ 5\ \ 4)_8$

$(10101101.10110)_2 = (0\ 1010\ 1101.1011\ 0000)_2$
$= (\ A\ \ D\ .\ B\ \ 0)_{16}$

$(10101101.10110)_2 = 1x2^7 + 0x2^6 + 1x2^5 + 0x2^4 + 1x2^3$
$+ 1x2^2 + 0x2^1 + 1x2^0 + 1x2^{-1} + 0x2^{-2}$
$1x2^{-3} + 1x2^{-4}$
$= (173.6875)_{10}$

Q2: Convert le following number into (i) Binary, (ii) Octal, (iii) Decimal: $(FD8.C2B)_{16}$

F = 1111
D = 1101
8 = 1000
C = 1100
2 = 0010
B = 1011

$(FD8.C2B)_{16} = (1111\ 1101\ 1000.\ 1100\ 0010\ 1011)_2$
$= (111\ 111\ 011\ 000.110\ 000\ 101\ 011)_2$
$= (7730.6053)_8$
$= 15x16^2 + 13x16^1 + 8x16^0 + 12x16^{-1} + 2x16^{-2} + 11x16^{-3}$
$= 3840 + 208 + 128 + 0.75 + 0.0078125 + 0.003906$
$= 4176.76171875$

Q3: Perform the following subtraction using 1's CF:
10110.01 – 11010.10

1's CF of 11010.10 is 00101.01

```
  10110.01
+ 00101.01
 ------------
  11011.10
```

It is a negative number thus take its 1's CF and put a (-) in front: - 00100.01

Q4: Assume 7-bit word length for a signed binary integers representation. After finding the representations of (+42), (-42), (+13), (-13) in 2's CF, perform:

a) (+ 42) + (- 13) using addition in 2's CF

b) (- 42) - (+ 13) using subtraction in 2's CF.

$(+42)_{10} = (0101010)_2$ **$(+13)_{10} = (0001101)_2$**

$(-42)_{10} = (1010110)_2$ **$(-13)_{10} = (1110011)_2$**

a)

```
      (+ 42)  0101010
    + (-  13)  1110011
      -------  ----------
      (+ 29)  0011101 (in 2's CF)
```

b)

```
      (-  42)  1010110
    + (-  13)  1110011
      -------  -----------
      (-  55)  1001001 (in 2's CF)
```

Q5: Convert A= 16.25 and B = 8.25 into binary, use 7 bits to represent the integral part and 3 bits to represent the fractional part, then perform the following operations in binary.

a) C= A + B

b) D = A - B Using unsigned binary

c) E = A - B Using signed 2's complement

$16 = 2^4 = 1x2^4 + 0x2^3 + 0x2^2 + 0x2^1 + 0x2^0 = (0010000)_2$

$8 = 2^3 = 1x2^3 + 0x2^2 + 0x2^1 + 0x2^0 = (0001000)_2$

$.25 = ¼ = 2^{-2} = 0x2^{-1} + 1x2^{-2} = (.010)_2$

$16.25 = (0010000.010)_2$

$8.25 = (0001000.010)_2$

```
C = A+B:      0010000.010
            + 0001000.010
              -----------------
              0011000.100

D = A-B:      0010000.010
            - 0001000.010
              -----------------
              0001000.000
```

Using 2's CF:
-B = 1110111.101 + 0000000.001 = 1110111.110

E = A-B: 0010000.010
+ 1110111.110
----
(1)0001000.000 Discard the carry (1) → 0001000.000

Q6: In a 6-bit wide signed binary representation is there an overflow for the following operations:

a) (+17) + (+16)
b) (+17) + (-17)

a) +17 = 010001
+ +16 = 010000

100001 = - (11111) = - 31
The first digit indicates that it is a negative number → Overflow

b) +17 = 010001
+ -17 = 101111 2's CF(010001) = 101110 + 000001 = 101111

1000000 because it involves a 2's complement (for the negative number) the carry out is discarded
000000 = 0 → No overflow
In addition we are dealing with the addition of a positive number with a negative number which can not lead to an overflow