NUMBER SYSTEMS - ASSIGNMENT II

1. **What is 2's complement of a negative number? How is it found?**

   Ans: 2's complement of a negative number is a positive number which is obtained by taking negation of the bits and adding 1 to it.

   example: -25 in binary is 00111. Take 1's complement 11000. add 1 we get 11001.

2. **How is 2's complement used in subtraction? If the answer is negative, how can you find its magnitude?**

   Ans: A-B is same as A+(2's complement of B). Hence using 2's complement method we can perform the subtraction of 2 numbers by simple addition. The MSB bit will indicate the sign. If it is 1 then the number is negative else it is positive.

3. **Perform the following operations(Use 2's complement method).**
   a. **10101.10101 - 110011**
   b. **01110.1001 – 00011.1110**

   Ans:

   a. 0011101.01010

   b. 1001010.1011

4. **Add the following decimal numbers in 8-bit 2's complement form:**

   (a) +45 –56 (b) + 67 –98

   Ans:

   a). 00001011

   b). 00011111

5. **Find the 8-bit subtraction of the following decimal number in 2's and 1's complement form:**

(a) +54, +65 (b) −25, −66

Ans:

a). 00001011(2’s complement)

b). 01011011(2’s complement)

6. **Convert the following sign-magnitude numbers into decimal form:**

   (a) 1001100110 (b) 100 1100 (c) 01110101

   Ans: (a) -102 (b) -10 (c)117

7. **Using 2's complement, find 1110.1001 − 0011.1110**

   Ans: 01010.1011

8. **Using 2’s complement, find:**

   i. **67 - 35**

   ii. **23 - 43**

   iii. **- 16 - 18**

   iv. **- 20 + 10**

   v. **- 86 - 24**

Ans: i. (00100000)2 --> (32)10

ii. (0010100)2 (-20)10

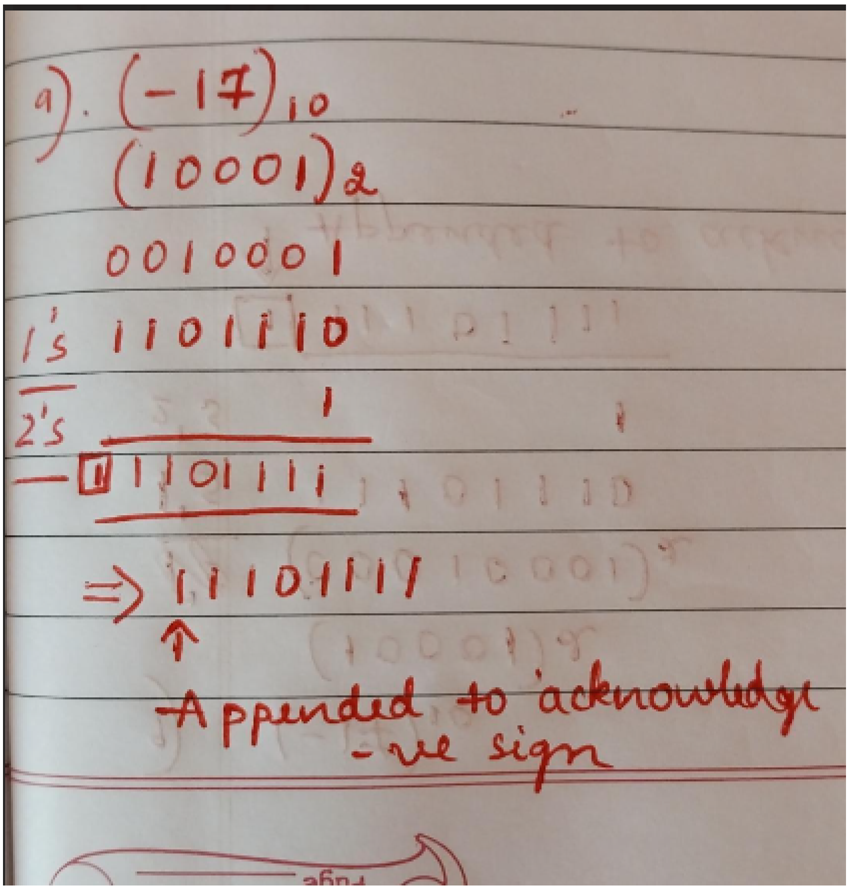
iii. (100010)2

Iv. (1010)2 --> (-10)10

V. (01101110)2

9. **Represent $(-17)_{10}$ and $(-22)_{10}$ in 8-bit 2's complement notation.**

   Ans: (-17)10



(-22)10 --> (11101010)2

10. Perform (22 - 17) and (17 - 22) directly by 2's and 1's complement notation.

Ans: 22-17 --> (000101)2

17-22 --> -(101)2

11. Encode the decimal numbers 43_{10} and 295_{10} in:

(a) Binary code (b) BCD code (c) Octal code

(d) Hexadecimal code

Ans: a) $(43)_{10} = (101011)_2$, $(295)_{10} = (100100111)_2$

b) $(43)_{10}$ = 01000011, $(295)_{10}$ = (001010010101)

c) $(43)_{10} = (53)_8$, $(295)_{10} = (447)_8$

d) $(43)_{10} = (2B)_{16}$, $(295)_{10} = (127)_{16}$

12. **What is BCD, Excess-3 and Gray code?**

Ans: BCD: BCD is a 4-bit code, so it can represent decimal numbers from 0 to 9 for each digit.

Excess-3: Excess-3 Code is a non-weighted BCD (8421) Code. Excess-3 Code is derived from 8421 code by adding 0011 (3) to all code groups.

Gray code: Gray code is a binary numeral system where two consecutive values differ in only one bit

13. **Convert the following binary numbers to decimal: 101110; 1110101; and 110110100.**

Ans: 46; 117; 436

14. **Convert the following decimal numbers to binary: 1231; 673; and 1998.**

Ans: 10011001111; 1010100001; 11111001110

15. **Convert the following decimal numbers to the bases indicated.**

a.7562 to octal

b.1938 to hexadecimal

c.175 to binary

Ans: a) 16612

b) 792

c) 10101111

16. **Convert the hexadecimal number F3A7C2 to binary and octal.**

Ans: 111100111010011111000010; 74723702

17. **Obtain the 9's complement of the following eight-digit decimal numbers: 12349876; 00980100; 90009951; and 00000000.**

Ans: 99999999 - 12349876 = 87650123

99999999 - 00980100 = 99019899

99999999 - 90009951 = 09990048

99999999 - 00000000 = 99999999

18. **Obtain the 10's complement of the following six-digit decimal numbers: 123900; 090657; 100000; and 000000.**

Ans: 876100, 909343, 900000, 000000

19. **Obtain the 1's and 2's complements of the following eight-digit binary numbers: 10101110; 10000001; 10000000; 00000001; and 00000000.**

Ans: 1s: 01010001, 2s: 01010010;

1s: 01111110, 2s: 01111111;

1s: 01111111, 2s: 10000000;

1s: 11111110, 2s: 11111111;

1s: 11111111, 2s: 100000000;

20. **Perform the subtraction with the following unsigned decimal numbers by taking the 10's complement of the subtrahend.**

a. 5250 - 1321

b. 1753 – 8640

c. 20 - 100

d. 1200 - 250

Ans:

a) 5250 - 8679 = -3429
b) 1753 - 1360 = 393
c) 20 - 900 = -880
d) 1200 - 750 = 450

21. Perform the subtraction with the following unsigned binary numbers by taking the 2's complement of the subtrahend.

a. 11010 - 10000

b. 11010 - 1101

c. 100 - 110000

d. 1010100 - 1010100

Ans:

a. 001010 with carry 1(discarded)
b. 01101 with carry 1(discarded)
c. -(101100) with carry 0
d. 0

22. Perform the arithmetic operations (+42) + (-13) and (-42) - (-13) in binary using signed-2's complement representation for negative numbers.

Ans: 101010 + 1110011 = 0011101 with carry 1(discarded)

1010110 + 1110011

23. **Perform the arithmetic operations (+70) + (+80) and (-70) + (-80) with binary numbers in signed-2's complement representation. Use eight bits to accommodate each number together with its sign. Show that overflow occurs in both cases, that the last two carries are unequal, and that there is a sign reversal.**

Ans: (a)

Soln: (a) +70 + 80

sign bits

+70	$\xrightarrow{\text{binary}}$	0100 0110
+80	$\longrightarrow$	0101 0000
+150		1001 0110

$\{ 2^7 \; 2^6 \; 2^5 \cdots 2^0 \}$

sign bit

In signed representation $\left\{ \begin{array}{l} 1 \to \text{negative} \\ 0 \to \text{positive} \end{array} \right\}$

While storing a signed 8 bit number it stores it as a negative number (since 1 is present in MSB) $\Rightarrow$ Overflow happened.

(b)

(3). (-70) + (-80)

$$-70 \longrightarrow 0100\ 0110 \xrightarrow{2's} \begin{array}{r} 1011\ 1001 \\ +1 \\ \hline 1011\ 1010 \end{array}$$

$$-80 \xrightarrow{binary} 0101\ 0000 \xrightarrow{2's} \begin{array}{r} 1010\ 1111 \\ +1 \\ \hline 1011\ 0000 \end{array}$$

$$\begin{array}{r} -70 \\ -80 \\ \hline -150 \end{array}$$

$$\begin{array}{r} 1011\ 1010\ + \\ 1011\ 0000 \\ \hline \cancel{1}\ 0110\ 1010 \end{array}$$

Stores it as a positive number ⇒ overflow happened

$$\begin{array}{r} -ve \\ -ve \\ \hline -ve \end{array} \quad \text{but} \Rightarrow \quad \begin{array}{r} -ve \\ -ve \\ \hline +ve \end{array}$$

24. Perform the following arithmetic operations with the decimal numbers using signed-10's complement representation for negative numbers.

a. (- 638) + (+ 785)

b. (- 638) - (+ 185)

Ans: a. (147)10

b. -(823)10

25. Using this property of the Gray code, obtain:

a. The Gray code numbers for 16 through 31.

Decimal	Binary	Gray code
16	10000	11000
17	10001	11001
18	10010	11011
19	10011	11010
20	10100	11110
21	10101	11111
22	10110	11101
23	10111	11100
24	11000	10100
25	11001	10101
26	11010	10111
27	11011	10110
28	11100	10010
29	11101	10011
30	11110	10001
31	11111	10000

b. The excess-3 Gray code for decimals 10 to 19.

b). The excess-3 gray code for decimals 10 to 19.

Decimal	binary	Excess-3
10	1010	1101
11	1011	1110
12	1100	1111
13	1101	10000
14	1110	10001
15	1111	10010
16	10000	10011
17	10001	10100
18.	10010.	10101
19	10011	10110

26. **Represent decimal number 8620 in (a) BCD; (b) excess-3 code; (c) 2421 code; (d) as a binary number.**

Ans:

(a) 1000011000100000

(b) 10000110101111

(c.) 1110110000100000

(d) 10000110101100

27. **Represent decimal 3984 in the 2421 code. Complement all bits of the coded number and show that the result is the 9' s complement of 3984 in the 2421 code.**

27. $3984 = (0011\ 1111\ 1110\ 0100)_{2421}$

$\downarrow$ complement

$= (1100\ 0000\ 0001\ 1011)_{\overline{2421}}$

$(3984)_{\overline{2421}} = (6\quad 0\quad 1\quad 5)_{10}$ — ①

$3984 \xrightarrow{9\text{'s compl}} (10^4 - 1) + 3984 = \underline{\underline{6015}}$ — ②

Eqn ① & ② are equal.