Q.N 5.1 a>

The maximum number of values we can have is $b^n = 5^4 = 625$

Lets split it into two, like we are having a bias in the system,

So, $\dfrac{b^n - 1}{2} = (312)_{10}$

Now,

$(312)_{10} \rightarrow (?)_5$

$312 \bmod 5 \equiv 2$

$\hookrightarrow 62 \bmod 5 \equiv 2$

$\hookrightarrow 12 \bmod 5 \equiv 2$

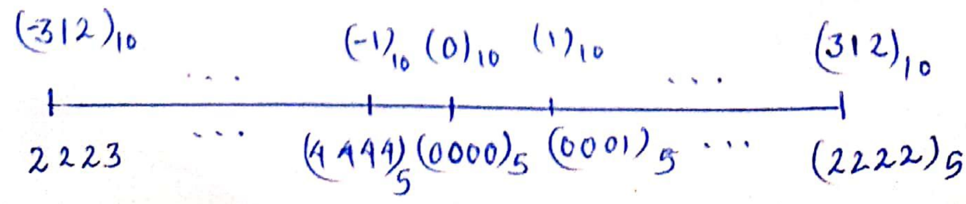
$\hookrightarrow 2 \bmod 5 \equiv 2$

Hence, the largest number is $(2222)_5$

And the smallest is $(2222)_5 + (1)_5$

$= (2223)_5$

which is also equivalent to $(-312)_{10}$.



Q.N 5 b) $\underline{\text{sol}^n}$

$abs((-1)_{10}) = (1)_{10} = (0001)_5$

$abs((-8)_{10}) = (8)_{10} = (0013)_5$

$a_i' = (b-1) - a_i$

$\therefore a_0 = (5-1) - 1 = 3$

$a_1 = (5-1) - 0 = 4$

$a_2 = (5-1) - 0 = 4$

$a_3 = (5-1) - 0 = 4$

$\therefore a' + 1 = (4444)_5$

$a_0 = (5-1) - 3 = 1$

$a_1 = (5-1) - 1 = 3$

$a_2 = (5-1) - 0 = 4$

$a_3 = (5-1) - 0 = 4$

$\therefore a' + 1 = (4432)_5$

So,

$(-1)_{10} \rightarrow (4444)_5$

$(-8)_{10} \rightarrow (4432)_5$

Q.N5 c) $\underline{\text{sol}^n}$

$(-1)_{10} + (-8)_{10} \rightarrow (?)_5 \longrightarrow (?)_{10}$

In b-complement relation,

$$\begin{array}{r} (4444)_5 \\ +\ (4432)_5 \\ \hline 111 \\ \hline \cancel{1}(4431)_5 \end{array}$$

Now,

converting $(4431)_5$ back to decimal.

First,

$$a_i' = (b-1) - a_i$$

$$a_0 = (5-1) - 1 = 3$$

$$a_1 = (5-1) - 3 = 1$$

$$a_2 = (5-1) - 4 = 0$$

$$a_3 = (5-1) - 4 = 0$$

Now,

$$a' + 1 = (0014)_5$$

Converting back to decimal,

$$0 \times 5^3 + 0 \times 5^2 + 0 \times 5^1 + 4 \times 5^0$$

$$= 5 + 4 = 9$$

$$\therefore (4431)_5 = -(0014)_5 = (-9)_{10}$$

Q. N 2a) Soln

As -233.15 is negative the sign bit will be 1

Converting 273 into binary, and 0.15 in binary.

$273 \mod 2 \equiv 1$	$0.15 \times 2 = 0.3 \rightarrow 0$
$136 \mod 2 \equiv 0$	$0.3 \times 2 = 0.6 \rightarrow 0$
$68 \mod 2 \equiv 0$	$0.6 \times 2 = 1.2 \rightarrow 1$
$34 \mod 2 \equiv 0$	$0.2 \times 2 = 0.4 \rightarrow 0$
$17 \mod 2 \equiv 1$	$0.4 \times 2 = 0.8 \rightarrow 0$
$8 \mod 2 \equiv 0$	$0.8 \times 2 = 1. \rightarrow 1$
$4 \mod 2 \equiv 0$	$0.6 \times 2 = 1.2 \rightarrow 1$
$2 \mod 2 \equiv 0$	$0.2 \times 2 = 0.4 \rightarrow 0$
$1 \mod 2 \equiv 1$	$0.4 \times 2 = 0.8 \rightarrow 0$
	$0.8 \times 2 = 1.6 \rightarrow 1$
$(273)_{10} \longrightarrow (100010001)_2$	
	$(0.15)_{10} \rightarrow (10010011\overline{001})_2$

Together,

$$(100010001.\ 0010011\overline{001})_2$$

$$\hookrightarrow (1.00010001001001 1\overline{001})_2 \times 2^8$$

As the exponent bias is 127 so,

$127 + 8 = (135)_{10} \rightarrow (10000111)_2$

So, for mantessa we have,

$(00010001001001100110011)_2$

So, we can get,

S	Exponent	Mantissa (23 bits)
1	10000111	00010001001001100110011

Q.N 2.b) Soln

$S = 1$ so it's a negative number,

$(10000111)_2 \rightarrow (135)_{10} \rightarrow 135 - 127$
$= 8$

$(1.00010001001001100110011) \times 2^8$

$\Rightarrow 100010001.001001100110011$

Splitting the before and after decimal point.

$= (100010001)_2 \rightarrow (273)_{10}$

And

for, $(.001001100110011)_2$

we can do,

$$\left(1\times 2^{-3} + 1\times 2^{-6} + 1\times 2^{-7} + 1\times 2^{-10} + 1\times 2^{-11} + 1\times 2^{-14} + 1\times 2^{-15}\right)$$

$$= \frac{4915}{32768} = 0.1499938964484375$$

$\therefore$ The actual fraction stored in computer is $(-273.1499938964484375)_{10}$

Q.N 5.3) Soln

f0 9f 90 81

As the above UTF-8 sequence have 8 characters of hexadecimal value which has in total of 32 bits.

Lets convert the UTF-8 hex. code into binary with 1 byte seperation.

$$\underbrace{11110}_{\times}\underbrace{000}_{000} \quad \underbrace{10}_{\times}\underbrace{011111}_{011111} \quad \underbrace{10}_{\times}\underbrace{010000}_{010000} \quad \underbrace{10}_{\times}\underbrace{000100}_{000100}$$

Grouping them into four,

Bin	0	0001	1111	0100	0000	0100
Hex		1	f	4	0	4

On unicode representation U+1F404 and it gives us a symbol of cow.