EE2026 (Part 1)
Tutorial 1 - Solutions

1. (a) Iteratively divide by two (remainder's division progressively gives digits)

$$\begin{array}{r|l} 2 & 166 \\ \hline 83 & 0 \\ 41 & 1 \\ 20 & 1 \\ 10 & 0 \\ 5 & 0 \\ 2 & 1 \\ 1 & 0 \\ 0 & 1 \end{array}$$

$.34\times 2 = \mathbf{0}.68 \rightarrow .68\times 2 = \mathbf{1}.36 \rightarrow .36\times 2 = \mathbf{0}.72 \rightarrow .72\times 2 = \mathbf{1}.44.....$
$= (10100110.0101\ldots)_2$

(b)
$$\begin{array}{r|l} 16 & 1400 \\ \hline 87 & 8 \\ 5 & 7 \\ 0 & 5 \end{array}$$

$.16\times 16 = \mathbf{2}.56 \rightarrow .56\times 16 = \mathbf{8}.96 \rightarrow .96\times 16 = \mathbf{F}.36 \rightarrow .36\times 16 = \mathbf{5}.76.....$
$= (578.28F5....)_{16}$

(c) Group digits in 3-digit sets and convert digit by digit

$$\underset{5}{\{}010\ \underset{3}{\{}111\ \underset{4}{\{}00.\underset{0}{\{}001\ \underset{7}{\{}11$$
$= (534.07)_8$

(d) Group digits in 4-digit sets and convert digit by digit

$$A59.FCE = \{1010\ \ \{0101\ \ \{1001 \bullet \{1111\ \ \{1100\ \ \{1110$$

(e) By definition of positional number system:

$$6\cdot x^1 + 2\cdot x^0 - \left(2\cdot x^1 + 6\cdot x^0\right) = 3\cdot x^1 + 4\cdot x^0$$
$$\left(6-2-3\right)\cdot x + \left(2-6-4\right) = 0$$

$\therefore x = 8$ (octal)

2. First look at the sign from the MSB, then convert the remaining bits (magnitude) as usually done in conversion from decimal to binary (iterative divisions)

Decimal	Sign Mag.
127	01111111
-0	10000000
-55	10110111

3. Look at the sign, just convert from decimal to binary if positive , or reverse all bits of magnitude if negative

Decimal	1's Comp.
43	0000101011
-1	1111111110
-128	1101111111

4. The objective is to derive sign and magnitude of the signed decimal number.
Look at the MSB to know about the sign. Regarding the magnitude, from the definition of 2'complement representation we proceed as follows:
   - if positive (MSB=0), the 2's complement representation is equal to the magnitude, hence simply convert the number from binary to decimal
   - if negative (MSB=1), the 2's complement representation is the 2's complement of the magnitude. To evaluate the magnitude from the 2's complement of a binary number, recall that the 2's complement A^* of a number with magnitude A is $A^*=2^n-A$, hence the magnitude A is immediately found to be $A=2^n- A^*$. More explicitly, the magnitude is found by simply performing the 2'complement of A^*. In this case

(a) $10000(2's) \xrightarrow{2's\ complement} 10000(magnitude) \rightarrow -16$

(b) $10000001(2's) \xrightarrow{2's\ complement} 01111111(magnitude) \rightarrow -127$