EEEN 222 HW 1
SOLUTIONS

1) a) $(0111001)_2 = (?)_{10}$

$$0\cdot 2^6 + 1\cdot 2^5 + 1\cdot 2^4 + 1\cdot 2^3 + 0\cdot 2^2 + 0\cdot 2^1 + 1\cdot 2^0 = \underline{(58)_{10}}$$

b) $(7654569)_{13} = (?)_{10}$

$$7\cdot 13^6 + 6\cdot 13^5 + 5\cdot 13^4 + 4\cdot 13^3 + 5\cdot 13^2 + 6\cdot 13^1 + 9\cdot 13^0 =$$

$$= \underline{(36167946)_{10}}$$

2) $(2198,0125)_{10} = (?)_2$

2198	2	1099	2198	0
1099	2	549	1098	1
549	2	274	548	1
274	2	137	274	0
137	2	68	136	1
68	2	34	68	0
34	2	17	34	0
17	2	8	16	1
8	2	4	8	0
4	2	2	4	0
2	2	1	2	0
1				

$(2198,0125)_{10} = (100010010110,?)_2$

$0,0125 \times 2 = \boxed{0},0250$

$0,0250 \times 2 = \boxed{0},05$

$0,05 \times 2 = \boxed{0},1$

$0,1 \times 2 = \boxed{0},2$

$0,2 \times 2 = \boxed{0},4$

$0,4 \times 2 = \boxed{0},8$

$0,8 \times 2 = \boxed{1},6$

$0,6 \times 2 = \boxed{1},2$

$0,2 \times 2 = \boxed{0},4$ ← Repeating

⋮

Therefore,

$$\underline{(2198,0125)_{10} = (100010010110,000000110\ldots)_2}$$

3) a)

```
  1100111
+   11001
---------
 10000000
```

b)

```
       10001001
  x      101110
---------------
      00000000
     10001001
    10001001
   10001001
  00000000
+10001001
---------------
11000100111110
```

c)

```
  1010011
- 10001110
----------
     ?
```

Find 2's complement of 10001110

1's comp. → 01110001

```
  01110001
+        1
----------
  01110010 → 2's comp.
```

```
  1010011
+ 01110010
----------
  11000101
```

→ No overflow!
Therefore, find 2's comp. of the result
Then put a minus sign in front of it

11000101 $\xrightarrow{\text{1's comp}}$ 00111010

```
  00111010
+        1
----------
  00111011 → 2's comp.
```

```
   1010011
 - 10001110
-----------
 -00111011
```

4) a) $(93)_a + (42)_a = (105)_a \quad a = ?$

$9a + 3 + 4a + 2 = a^2 + 5$

$a^2 - 13a = 0$

$a(a-13) = 0 \Rightarrow a = 0 \quad a = 13$

$\times \quad \checkmark$

b) $(223)_b \,/\, (7)_b = (25)_b \Rightarrow b > 7$

$$\frac{2b^2 + 2b + 3}{7} = 2b + 5$$

$2b^2 + 2b + 3 = 14b + 35$

$2b^2 - 12b - 32 = 0 \Rightarrow (2b+4)(b-8) = 0$

2   -4
1   -8

$b = -2 \quad b = 8$

$\times \quad \checkmark$

5) $F(A,B,C,D) = A' + CD + ABC' + B'D + ABD'$

We will use quicker way

Minterms of A': $\underset{A}{\underline{0}}\ \underset{B}{\underline{\overset{0}{1}}}\ \underset{C}{\underline{\overset{0}{1}}}\ \underset{D}{\underline{\overset{0}{1}}} \Rightarrow \begin{matrix} m_0 \\ m_1 \\ m_2 \\ \vdots \\ m_7 \end{matrix}$

Minterms of CD: $\underset{A}{\underline{\overset{0}{1}}}\ \underset{B}{\underline{\overset{0}{1}}}\ \underset{C}{\underline{1}}\ \underset{D}{\underline{1}} \Rightarrow \begin{matrix} m_3 \\ m_7 \\ m_{11} \\ m_{15} \end{matrix}$

Minterms of ABC': $\underset{A}{\underline{1}}\ \underset{B}{\underline{1}}\ \underset{C}{\underline{0}}\ \underset{D}{\underline{\overset{0}{1}}} \Rightarrow \begin{matrix} m_{12} \\ m_{13} \end{matrix}$

Minterms of $B'D$: $\underset{A}{\underline{\overset{0}{1}}}\ \underset{B}{\underline{0}}\ \underset{C}{\underline{\overset{0}{1}}}\ \underset{D}{\underline{1}} \Rightarrow \begin{matrix} m_1 \\ m_3 \\ m_9 \\ m_{11} \end{matrix}$

Minterms of ABD': $\underset{A}{\underline{1}}\ \underset{B}{\underline{1}}\ \underset{C}{\underline{\overset{1}{0}}}\ \underset{D}{\underline{0}} \Rightarrow \begin{matrix} m_{12} \\ m_{14} \end{matrix}$

Therefore

$$F(A,B,C,D) = \Sigma m(0,1,2,3,4,5,6,7,9,11,12,13,14,15)$$

$$= \Pi M(8,10)$$

6)

$$F(A,B,C,D) = A'BC'D + A'BCD + AB'CD' + ABCD$$

$$F = a_0 \oplus a_1 A \oplus a_2 B \oplus a_3 C \oplus a_4 D \oplus a_5 AB \oplus a_6 AC \oplus a_7 AD$$
$$\oplus\, a_8 BC \oplus a_9 BD \oplus a_{10} CD \oplus a_{11} ABC \oplus a_{12} ABD \oplus a_{13} ACD$$
$$\oplus\, a_{14} BCD \oplus a_{15} ABCD$$

$f(0,0,0,0) = a_0 = 0$

$f(1,0,0,0) = a_0 \oplus a_1 = 0 \Rightarrow a_1 = 0$

$f(0,1,0,0) = a_0 \oplus a_2 = 0 \Rightarrow a_2 = 0$

$f(0,0,1,0) = a_0 \oplus a_3 = 0 \Rightarrow a_3 = 0$

$f(0,0,0,1) = a_0 \oplus a_4 = 0 \Rightarrow a_4 = 0$

$f(1,1,0,0) = a_0 \oplus a_1 \oplus a_2 \oplus a_5 = 0 \Rightarrow a_5 = 0$

$f(1,0,1,0) = a_0 \oplus a_1 \oplus a_3 \oplus a_6 = 1 \Rightarrow a_6 = 1$

$f(1,0,0,1) = a_0 \oplus a_1 \oplus a_4 \oplus a_7 = 0 \Rightarrow a_7 = 0$

$f(0,1,1,0) = a_0 \oplus a_2 \oplus a_3 \oplus a_8 = 0 \Rightarrow a_8 = 0$

$f(0,1,0,1) = a_0 \oplus a_2 \oplus a_4 \oplus a_9 = 1 \Rightarrow a_9 = 1$

$f(0,0,1,1) = a_0 \oplus a_3 \oplus a_4 \oplus a_{10} = 0 \Rightarrow a_{10} = 0$

$f(1,1,1,0) = a_0 \oplus a_1 \oplus \dots \oplus a_6 \oplus a_8 \oplus a_{11} = 0 \Rightarrow a_{11} = 0$

$f(1,1,0,1) = \dots \oplus a_9 \oplus a_{12} = 0 \Rightarrow a_{12} = 0$

$f(1,0,1,1) = \dots \oplus a_{10} \oplus a_{13} = 0 \Rightarrow a_{13} = 0$

$f(0,1,1,1) = a_0 \oplus a_2 \oplus a_3 \oplus a_4 \oplus a_8 \oplus a_9 \oplus a_{10} \oplus a_{14} = 1 \Rightarrow a_{14} = 1$

$f(1,1,1,1) = a_0 \oplus a_1 \oplus \dots \oplus a_{15} = 1 \Rightarrow a_{15} = 1$

$\Rightarrow f = AC \oplus BD \oplus BCD \oplus ABCD$