EMTR-2011: Microcontrollers and Digital Logic
Assignment 1 Reference Solution

1. Binary to Decimal.

$11101101_2$ to Decimal.

$= 1\times2^0 + 0\times2^1 + 1\times2^2 + 1\times2^3 + 0\times2^4 + 1\times2^5 + 1\times2^6 + 1\times2^7$.

$= 237_{10}$ (Ans.)

2. Binary to Hex.

$\underbrace{1010}_{A}\ \underbrace{1101}_{D}\ \underbrace{0111}_{7}$

Ans: $AD7_{16}$

3. ~~2~~ Hex to Binary.

$32B_{16}$

$3 \to 0011$, $2 \to 0010$, $B \to 1011$

Ans. 0011 0010 $1011_2$

4. Hexadecimal to Decimal.

$\boxed{B=12}$

a) $6B2_{16}$

$= \cancel{2}\ 6\times16^2 + 11\times\cancel{1}16^1 + 2\times16^0$

$= 1536+176+2$

$= 1714$.

Ans: $1714_{10}$.

b) $9F2E_{16}$ Here, $f=15$, $E=14$

$= 9\times16^3 + 15\times16^2 + 2\times16^1 + 14\times16^0$

$= 40750_{10}$ (Ans).

Question 1(5)

(a)

$$16\overline{)75}\;=4,\quad 64,\quad 11 \qquad 16\overline{)4}\;=0,\quad 4$$

| | Q | R |
|---|---|---|
| 75D = | 2 | 11 (B) |
| | 0 | 4 |

4BH

(b)

$$16\overline{)938}\;=58,\quad 80,\quad 138,\quad 128,\quad 10 \qquad 16\overline{)58}\;=3,\quad 48,\quad 10 \qquad 16\overline{)3}\;=0,\quad 3$$

| | Q | R |
|---|---|---|
| 938D = | 58 | 10 (A) |
| | 3 | 10 (A). |
| | 0 | 3 |

3AAH

(c)

$$16\overline{)2048}\;=128,\quad 16,\quad 44,\quad 32,\quad 128,\quad 128,\quad 0 \qquad 16\overline{)128}\;=8,\quad 128,\quad 0 \qquad 16\overline{)8}\;=0,\quad 8$$

| | Q | R |
|---|---|---|
| 2048D = | 128 | 0 |
| | 8 | 0 |
| | 0 | 8 |

800H

Using 2's complement method to perform the following subtraction.

(a) 11011 − 10101

2's complement of 10101 is 01010. After adding 1 the result is 01011.

Now adding 11011 and 01011,

The answer is 100110

After removing the overflow the ~~resu~~ final result is 00110

(b) 110010 − 111001.

2's complement of 111001 is 000110. After adding 1 it is 000111.

Now adding 110010 and 000111 and the answer is 111001(Am).

3.(a)

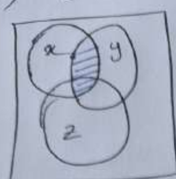
| $x$ | $y$ | $x\cdot y$ | $\overline{x\cdot y}$ | $\bar{x}$ | $\bar{y}$ | $\bar{x}+\bar{y}$ |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 |

L.H.S      R.H.S

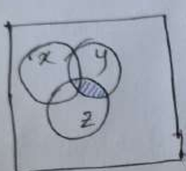
From the table ~~below~~ it is evident that L.H.S=RHS.

So, $\overline{x\cdot y} = \overline{x}+y$ is verified.

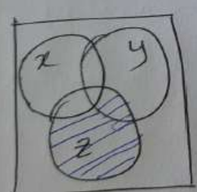
3.(b) Verify $x\cdot y + y\cdot z + \bar{x}\cdot z = x\cdot y + \bar{x}\cdot z$.



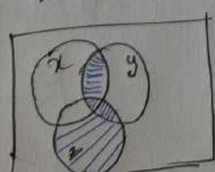

$x\cdot y$




$y\cdot z$

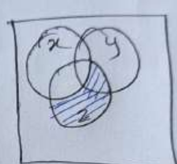



$\bar{x}\cdot z$

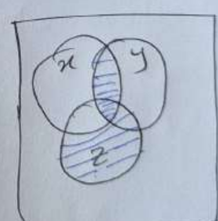



$x\cdot y + y\cdot z + \bar{x}\cdot z$


$x\cdot y$




$\bar{x}\cdot z$



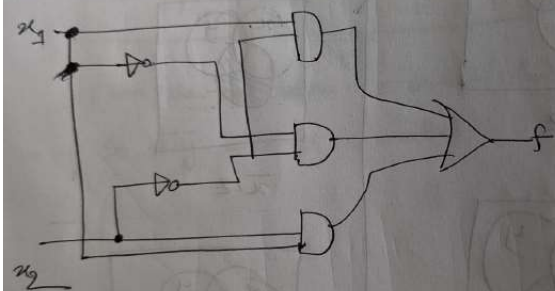

$\therefore$ L.H.S = R.H.S

[Verified]

4(a)

| $x_1$ | $x_2$ | $f$ |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

So, $f = \overline{x_1}\,\overline{x_2} + x_1\overline{x_2} + x_1 x_2$

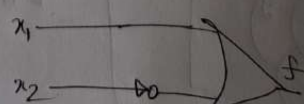



Simplifican of the circuit

$$f = \overline{x_1}\cdot\overline{x_2} + x_1\cdot\overline{x_2} + x_1 x_2 + x_1\overline{x_2}$$

$$= \overline{x_2}\left(\overline{x_1} + x_1\right) + x_1\left(x_2 + \overline{x_2}\right)$$

$$= \overline{x_2} + x_1$$




4(b) K-Map

| $x_1$ \ $x_2$ | $x_2=0$ | $x_2=1$ |
|---|---|---|
| $x_1=0$ | 1 | 0 |
| $x_1=1$ | 1 | 1 |

$f = \overline{x_2} + x_1$

5(a)

| $x_1$ | $x_2$ | $x_3$ | $f$ |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |

| $x_1$ \ $x_2$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| $x_3=0$ | 1 | 1 | 1 | 1 |
| $x_3=1$ | 0 | 0 | 0 | 1 |

$\overline{x_3} + x_1\overline{x_2}$

5(b)

| $x_1$ | $x_2$ | $x_3$ | $f$ |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |

| $x_3$ \ $x_1x_2$ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 1 | 1 |

$f = x_1x_2 + x_2 \cdot x_3 + x_1x_3$