Assignment 01

Abdullah Al Mazid Zomader

ID: 24241189

BRAC University

CSE260: Digital Logic Design

Mr. Mohammed Ashfaqul Haque

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Ans to the ques no-01

(a)

$(4195.25)_{10} = (?)_2$

2	4195	
2	2097	1
2	1048	1
2	524	0
2	262	0
2	131	0
2	65	1
2	32	1
2	16	0
2	8	0
2	4	0
2	2	0
2	1	0
	0	1

Now,

$0.25 \times 2 = 0.5$ 0

$0.5 \times 2 = 1.0$ 1

0

$\therefore (4195.25)_{10} = (1\ 0000\ 0110\ 0011.01)_2$

(b)

$(2356.54)_{10}$

2	2356	
2	1178	0
2	589	0
2	294	1
2	147	0
2	73	1
2	36	1
2	18	0
2	9	0
2	4	1
2	2	0
2	1	0
	0	1

And,

$$0.54 \times 2 = 1.08 \quad 1$$
$$0.08 \times 2 = 0.16 \quad 0$$
$$0.16 \times 2 = 0.32 \quad 0$$
$$0.32 \times 2 = 0.64 \quad 0$$
$$0.64 \times 2 = 1.28 \quad 1$$
$$\vdots \qquad \vdots \qquad \vdots$$

$$\therefore (2356.54) = (1001\ 0011\ 0100.10001\ldots)_2$$

Ans to the ques no-02

(a) $(5412)_7 = (?)_5$

Ans:

$$\underset{3}{5}\ \underset{2}{4}\ \underset{1}{1}\ \underset{0}{2}$$

$$(5412)_7 = 5\times7^3 + 4\times7^2 + 1\times7^1 + 2\times7^0$$

$$= (1920)_{10}$$

Now,

$$\begin{array}{r|l l}
5 & 1920 & \\
5 & 384 & 0 \\
5 & 76 & 4 \\
5 & 15 & 1 \\
5 & 3 & 0 \\
 & 0 & 3
\end{array} \uparrow$$

$$\therefore (1920)_{10} = (3\ 0140)_5$$

(b) $(434.156)_7$

Ans:

$$\underset{2}{4}\ \underset{1}{3}\ \underset{0}{4}\ .\ \underset{-1}{1}\ \underset{-2}{5}\ \underset{-3}{6}$$

$$\therefore (434.156)_7 = 4\times7^2 + 3\times7^1 + 4\times7^0 + 1\times7^{-1} + 5\times7^{-2} + 6\times7^{-3}$$

$$= (221.2623907)_{10}$$

Now,

$$
\begin{array}{r|l l}
5 & 221 & \\
5 & 44 & 1 \\
5 & 8 & 4 \\
5 & 1 & 3 \\
 & 0 & 1
\end{array}
\quad \uparrow
$$

And,

$$
\begin{array}{lll}
0.2623907 \times 5 & = 1.3119535 & 1 \\
0.3119535 \times 5 & = 1.5597675 & 1 \\
0.5597675 \times 5 & = 2.7988375 & 2 \\
0.7988375 \times 5 & = 3.9941875 & 3 \\
0.9941875 \times 5 & = 4.9709375 & 4 \\
\vdots & \vdots & \vdots
\end{array}
\quad \downarrow
$$

$\therefore (434.156)_7 = (1341.11234\ldots)_5$

③ Ans to the ques no-03

(a) $(1011\,0111)_2$

$$\underbrace{1011}_{B}\ \underbrace{0111}_{7}$$

$\therefore (10110111)_2 = (B7)_{16}$

Ans to the ques no - 3

(b)

$(11\ 1001\ 0011 . 1010\ 1000\ 1010\ 11)_2$

$$\underbrace{0011}_{3}\ \underbrace{1001}_{9}\ \underbrace{0011}_{3} . \underbrace{1010}_{A}\ \underbrace{1000}_{8}\ \underbrace{1010}_{A}\ \underbrace{1100}_{C}$$

$\therefore (11\ 1001\ 0011 . 1010\ 1000\ 101011)_2 = (393 . A8AC)_{16}$

Ans to the ques no - 04

(a)

$(010\ 110\ 111)_2$

$$\underbrace{010}_{2}\ \underbrace{110}_{6}\ \underbrace{111}_{7}$$

$\therefore (010110111)_2 = (267)_8$

(b) $(1\ 110\ 010\ 011 . 101\ 010\ 001\ 010\ 110)_2$

$$\underbrace{001}_{1}\ \underbrace{110}_{6}\ \underbrace{010}_{2}\ \underbrace{011}_{3} . \underbrace{101}_{5}\ \underbrace{010}_{2}\ \underbrace{001}_{1}\ \underbrace{010}_{2}\ \underbrace{110}_{6}$$

$\therefore (1110010011 . 101010001010110)_2 = (1623 . 52126)_8$

Ans to the ques no-05

(a) $(A9)_{11} = (?)_7$

$$\overset{1}{A}\ \overset{0}{9}$$

$\therefore (A9)_{11} = A \times 11^1 + 9 \times 11^0$

$= 10 \times 11 + 9$

$= (119)_{10}$

$\therefore$

$$\begin{array}{r|l l}
7 & 119 & \\
7 & 17 & 0 \\
7 & 2 & 3 \\
 & 0 & 2
\end{array}$$

$\therefore (A9)_{11} = (230)_7$

(b) $(11335)_7 = (?)_4$

$$\begin{array}{ccccc}
1 & 1 & 3 & 3 & 5 \\
\downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\
4 & 3 & 2 & 1 & 0
\end{array}$$

$\therefore (11335)_7 = 1 \times 7^4 + 1 \times 7^3 + 3 \times 7^2 + 3 \times 7^1 + 5 \times 7^0$

$= (2917)_{10}$

$$\begin{array}{r|l} 4 & 2917 \\ \hline 4 & 729 \quad 1 \\ \hline 4 & 182 \quad 1 \\ \hline 4 & 45 \quad 2 \\ \hline 4 & 11 \quad 1 \\ \hline 4 & 2 \quad 3 \\ \hline & 0 \quad 2 \end{array} \uparrow$$

$\therefore (11335)_7 = (231211)_4$

(c)

$(0011)_{BCD} = (?)_5$

$(0011)_{BCD} = (3)_{10}$

$$\begin{array}{r|l} 5 & 3 \\ \hline & 0 \quad 3 \end{array} \uparrow$$

$\therefore (0011)_{BCD} = (3)_5$

(d) $(1036)_{10} = (?)_{Excess-3}$

	BCD	Excess-3
1	0001	0100
0	0000	0011
3	0011	0110
6	0110	1001

$\therefore (1036)_{10} = (0100\ 0011\ 0110\ 1001)_{Excess\,3}$

(e) $(27841)_{10} = (?)_{Excess\text{-}5}$

	BCD	Excess-5
2	0010	0111
7	0111	1100
8	1000	1101
4	0100	1001
1	0001	0110

$\therefore (27841)_{10} = (0111\ 1100\ 1101\ 1001\ 0110)_{Excess\text{-}5}$

Ans to the ques no-06

$(101101)_2 = 1\times2^5 + 0 + 1\times2^3 + 1\times2^2 + 0 + 1\times2^0$

$= (45)_{10}$

$(57)_8 = 5\times8^1 + 7 = (47)_{10}$

$(35)_{10}$

$(1F)_{16} = 1\times16 + F$

$= 16 + 15$

$= (31)_{10}$

$\therefore (47)_{10} > (45)_{10} > (35)_{10} > (31)_{10}$

$\therefore (57)_8 > (101101)_2 > (35)_{10} > (1F)_{16}$

Ans to the ques no-07

$(417)_8 = 4 \times 8^2 + 1 \times 8 + 7 = (271)_{10}$

$(134)_8 = 1 \times 8^2 + 3 \times 8 + 4 = (92)_{10}$

Addition

$$\begin{array}{r} \overset{1}{4}17 \\ +\ 134 \\ \hline (553)_8 \end{array} \qquad \begin{array}{r} 1 \\ 8\,\overline{)\,11} \\ -8 \\ \hline 3 \end{array}$$

$\therefore (553)_8 = 5 \times 8^2 + 5 \times 8 + 3$

$= (363)_{10}$

$\therefore (271)_{10} + (92)_{10} = (363)_{10}$ (verified)

Subtraction

$$\begin{array}{r} \overset{+8}{3\,\cancel{4}17} \\ -\ 134 \\ \hline (263)_8 \end{array}$$

$(263)_8 = 2 \times 8^2 + 6 \times 8 + 3 = (179)_{10}$

$\therefore 271 - 92 = (179)_{10}$ (verified)

Multiplication

$$\begin{array}{r} \overset{3}{4}17 \\ \times\ 4 \\ \hline 2074 \end{array} \qquad \begin{array}{r} 3 \\ 8\,\overline{)\,28} \\ -24 \\ \hline 4 \end{array} \qquad \begin{array}{r} 2 \\ 8\,\overline{)\,16} \\ -16 \\ \hline 0 \end{array}$$

$$\begin{array}{r} \overset{2}{4}17 \\ \times\ 3 \\ \hline 1455 \end{array}$$

$$\begin{array}{r} 2 \\ 8\overline{)21} \\ -16 \\ \hline 5 \end{array} \qquad \begin{array}{r} 1 \\ 8\overline{)12} \\ -8 \\ \hline 4 \end{array}$$

$$\begin{array}{r} 417 \\ \times\ 1 \\ \hline 417 \end{array}$$

$$\therefore \begin{array}{r} 417 \\ \times\ 134 \\ \hline {}^{1}2{}^{1}074 \\ {}^{1}14550 \\ +41700 \\ \hline (60544)_8 \end{array}$$

$$\begin{array}{r} 1 \\ 8\overline{)12} \\ -8 \\ \hline 4 \end{array} \qquad \begin{array}{r} 1 \\ 8\overline{)13} \\ -8 \\ \hline 5 \end{array} \qquad \begin{array}{r} 1 \\ 8\overline{)8} \\ -8 \\ \hline 0 \end{array}$$

$\therefore (60544)_8 = (24932)_{10}$

$\therefore (271)_{10} \times (92)_{10} = (24932)_{10}$

Ans to the ques no-08

$(A3)_{16} = (163)_{10}$

$(A7)_{16} = (167)_{10}$

Addition:

$$\begin{array}{r} A3 \\ A7 \\ \hline (14A)_{16} \end{array} \qquad \begin{array}{r} 1 \\ 16\overline{)20} \\ -16 \\ \hline 4 \end{array}$$

$(14A)_{16} = 1 \times 16^2 + 4 \times 16 + 10 = (330)_{10}$

$\therefore (163)_{10} + (167)_{10} = (330)_{10}$ (verified)

Subtraction:

$$\begin{array}{r} A7 \\ -A3 \\ \hline (\quad 4)_{16} \end{array}$$

$\therefore (4)_{16} = (4)_{10}$

$\therefore (167)_{10} - (163)_{10} = (4)_{10}$ (verified)

Multiplication

$$\begin{array}{r} {}^{1}A3 \\ \times\ \ 7 \\ \hline 475 \end{array}$$

$$\begin{array}{r|l} & 1 \\ 16 & 21 \\ & -16 \\ \hline & 5 \end{array}$$

$$\begin{array}{r|l} & 4 \\ 16 & 71 \\ & -64 \\ \hline & 7 \end{array}$$

And,

$$\begin{array}{r} {}^{1}A3 \\ \times\ \ A \\ \hline 65E \end{array}$$

$$\begin{array}{r|l} & 1 \\ 16 & 30 \\ & 16 \\ \hline & 14 \\ & \downarrow \\ & E \end{array}$$

$$\begin{array}{r|l} & 6 \\ 16 & 101 \\ & -96 \\ \hline & 5 \end{array}$$

$$\therefore \begin{array}{r} A3 \\ \times A7 \\ \hline {}^{1}475 \\ +65E0 \\ \hline (6A55)_{16} \end{array}$$

$$\begin{array}{r|l} & 1 \\ 16 & 21 \\ & -16 \\ \hline & 5 \end{array}$$

$$\therefore (6A55)_{16} = 6 \times 16^3 + A \times 16^2 + 5 \times 16 + 5$$

$$= (27221)_{10}$$

$$\therefore (163)_{10} \times (167)_{10} = (27221)_{10} \quad \text{(verified)}$$

Ans to the ques no-09

$(-12345)_{10} = (?)_{15}$ in 16 bits

Ans:

$(12345)_{10}$ in binary

2	12345	
2	6172	1
2	3086	0
2	1543	0
2	771	1
2	385	1
2	192	1
2	96	0
2	48	0
2	24	0
2	12	0
2	6	0
2	3	0
2	1	1
	0	1

$\therefore (12345)_{10} = (11000000111001)_2$

Extending to 16 bits:

$(0011\ 0000\ 0011\ 1001)_2$

Applying 1s complement and inverting all bits:

$(1100\ 1111\ 1100\ 0110)_{15} = (-12345)_{10}$

Ans to the ques no-10

$(-2)_{10} = (?)_{1s}$ in 16 bits

Ans:

$(2)_{10}$ in binary

$$\begin{array}{r|l} 2 & 2 \\ \hline 2 & 1 \quad 0 \\ \hline & 0 \quad 1 \end{array} \uparrow$$

$(2)_{10} = (10)_2$

Extend it to 16 bits:

$(0000 \ 0000 \ 0000 \ 0010)_2$

Apply 1s complement:

$(1111 \ 1111 \ 1111 \ 1101)_{1s}$

$\therefore (-2)_{10} = (1111 \ 1111 \ 1111 \ 1101)_{1s}$ (Ans)

Ans to the ques no-11

Given,

$(1010\ 1010)_{1s}$

the given 1s complement is negative, due to having 1 as 1st bit.

∴ Inverting the whole given bits, we get.

$(0\,1\,0\,1\,0\,1\,0\,1)_2 = (1010\ 1010)_{1s}$

$$\therefore \begin{array}{cccccccc} 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \end{array}$$

$\therefore (01010101)_2 = 1 \times 2^6 + 1 \times 2^4 + 1 \times 2^2 + 1 \times 2^0$

$= (85)_{10}$.

$\therefore (1010\,1010)_{1s} = (-85)_{10}$ (Ans)

Ans to the ques no-012

Given,

$(10111100)_{2s}$; the number will be negative.

Inverting the given bits,

01000011

Adding +1 ,

$$
\begin{array}{r}
0\,1\,0\,0\,0\,0\,\overset{1}{1}\,\overset{1}{1} \\
+\;1 \\
\hline
(0\,1\,0\,0\,0\,1\,0\,0)_2
\end{array}
$$

$$\underset{7}{0}\,\underset{6}{1}\,\underset{5}{0}\,\underset{4}{0}\,\underset{3}{0}\;\underset{2}{1}\,\underset{1}{0}\,\underset{0}{0}$$

Now,

$(01000\ 100)_2 = 1\times2^6 + 1\times2^2$

$=(68)_{10}$

$\therefore (10111100)_{2s} = (-68)_{10}$ Ans

Ans to the ques no-13

Given,

$(-120)_{10}$

$120_{10} = (1111000)_2$

$+120_{10} = (01111000)_2$

2	120	
2	60	0
2	30	0
2	15	0
2	7	1
2	3	1
2	1	1
	0	1

$$\therefore (-120)_{10} = \begin{array}{r} (1\,0\,0\,0\,0\,1\,1\,1) \\ +\quad 1 \\ \hline (1\,0\,0\,0\,1\,0\,0\,0)_{2s} \end{array}$$

Ans to the ques no-14

As per question;

$91 - 499$

$= 91 + (-499)$

Now,

$(91)_{10} = (1011011)_2$

Extending upto 10 bits, we get,

$(91)_{10} = (0001011011)_2$

2	91	
2	45	1
2	22	1
2	11	0
2	5	1
2	2	1
2	1	0
	0	1

Now,

$(499)_{10} = (111110011)_2$

$\therefore (+499)_{10} = (0111110011)_2$

$\therefore (-499)_{10} = (1000001100)_{1s}$

$\therefore$ Adding $91 + (-499)$, we get,

$$\begin{array}{r} 0\,0\,0\,1\,0\,1\,1\,0\,1\,1 \\ +\ 1\,0\,0\,0\,0\,0\,1\,1\,0\,0 \\ \hline (1\,0\,0\,1\,1\,0\,0\,1\,1\,1)_2 \end{array}$$

2	499	
2	249	1
2	124	1
2	62	0
2	31	0
2	15	1
2	7	1
2	3	1
2	1	1
	0	1

Here,
91 is positive and -499 is negative (in 1s complement form). since, the operands have opposite sign, there is no overflow.

Ans to the ques no-15

Asperquestion;
211 + 312

$(211)_{10} = (1101\ 0011)_2$

$(+211)_{10} = (01101\ 0011)_2$

extending to 10 bits: $(+211)_{10} = (00\ 1101\ 0011)_2$

Again,

$(312)_{10} = (1\ 0011\ 1000)_2$

$(+312)_{10} = (01\ 0011\ 1000)_2$

Adding:

$$
\begin{array}{r}
\overset{1}{0}\ \overset{1}{0}\ \overset{1}{1}\ \overset{1}{1}\ \overset{1}{0}\ 1\ 0\ 0\ 1\ 1 \\
+\ 0\ 1\ 0\ 0\ 1\ 1\ 1\ 0\ 0\ 0 \\
\hline
(1\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 1\ 1)_{2s}
\end{array}
$$

Here, the 1st bit denotes that the ~~result of~~ addition will be negative. But, 211 and 312 are both positive. Thus, overflow is happening.

Ans to the ques no-16

511 - 1

= 511 + (-1)

Now,

$(511)_{10} = (1\ 1111\ 1111)_2$

$(+511)_{10} = (01\ 1111\ 1111)_2$

And,

$(1)_{10} = (1)_2$

$(+1)_{10} = (01)_2$

extending to 10 bits:

$(+1)_{10} = (00\ 0000\ 0001)$

Applying 2s complement:

inverting bits: 11 1111 1110

adding +1 : + 1

11 1111 1111

$\therefore (-1)_{2s} = 11\ 1111\ 1111$

Now, Adding,

```
      01 1111 1111
    + 11 1111 1111
extra
carry + (1) 01 1111 1110
                    +  1
      01 1111 1111
```

Here,

511 is positive and -1 is negative (in 2s complement)

Since, the operands have opposite sign, and the result is positive, there is no overflow.

Ans to the ques no-17

Here,

price of 1 stick RAM $= (1C2)_{16} = 1\times16^2 + 12\times16 + 2 = (450)_{10}\$$

$\therefore$ price of 2 sticks RAM $= (450\times2)\$ = 900\$$

price of 4070ti $= (100\ 1011\ 0000)_2$

$= 2^{10} + 2^7 + 2^5 + 2^4 = (1200)_{10}\$$

$\therefore$ total requirement $= (1200 + 900)\$ = 2100\$$

$\therefore$ Money given by friend $= (4064)_8 = 4\times8^3 + 0 + 6\times8^1 + 4\times8^0$

$= 2100\$$

$\therefore$ Money left after buying $= (2100 - 2100)\$$

$= 0\$$.

"Thanks THDJ"