Assignment 01

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CSE260: Digital Logic Design

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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,

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

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

Ans to the ques no-02

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

Ans:

$$\begin{array}{cccc} 5 & 4 & 1 & 2 \\ {\scriptstyle 3} & {\scriptstyle 2} & {\scriptstyle 1} & {\scriptstyle 0} \end{array}$$

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

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

Now,

5	1920	
5	384	0
5	76	4
5	15	1
5	3	0
	0	3

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

(b) $(434.156)_7$

Ans:

$$\begin{array}{ccccccc} 4 & 3 & 4 & \cdot & 1 & 5 & 6 \\ {\scriptstyle 2} & {\scriptstyle 1} & {\scriptstyle 0} & & {\scriptstyle -1} & {\scriptstyle -2} & {\scriptstyle -3} \end{array}$$

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

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

Now,

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

And,

$0.2623907 \times 5 = 1.3119535 \quad 1$

$0.3119535 \times 5 = 1.5597675 \quad 1$

$0.5597675 \times 5 = 2.7988375 \quad 2$

$0.7988375 \times 5 = 3.9941875 \quad 3$

$0.9941875 \times 5 = 4.9709375 \quad 4$

$\vdots \qquad \vdots \qquad \vdots$

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

(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)

$(010110111)_2$

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

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

(b) $(1110\ 010\ 011.101\ 010\ 001\ 010\ 110)_2$

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

$\therefore (1110010011.101010001010110)_2 = (1623.52126)_8$

<u>Ans to the ques no-05</u>

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

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

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

$= 10 \times 11 + 9$

$= (119)_{10}$

$\therefore$

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

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

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

$$(\overset{\downarrow}{\underset{4}{1}}\ \overset{\downarrow}{\underset{3}{1}}\ \overset{\downarrow}{\underset{2}{3}}\ \overset{\downarrow}{\underset{1}{3}}\ \overset{\downarrow}{\underset{0}{5}})$$

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

$= (2917)_{10}$

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

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

(c)

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

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

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

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

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

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

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

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

$(417)_8 = 4\times8^2 + 1\times8 + 7 = (271)_{10}$

$(134)_8 = 1\times8^2 + 3\times8 + 4 = (92)_{10}$

Addition

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

$\therefore (553)_8 = 5\times8^2 + 5\times8 + 3$

$= (363)_{10}$

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

Subtraction

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

$(263)_8 = 2\times8^2 + 6\times8 + 3 = (179)_{10}$

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

Multiplication

$$\begin{array}{r} \overset{3}{4}17 \\ \times\ 4 \\ \hline 2074 \end{array} \qquad \begin{array}{r|l} & \overset{3}{28} \\ 8 & -24 \\ \hline & 4 \end{array} \qquad \begin{array}{r|l} & \overset{2}{16} \\ 8 & -16 \\ \hline & 0 \end{array}$$

$$\begin{array}{r} \overset{2}{4}17 \\ \times\ 3 \\ \hline 1455 \end{array} \qquad \begin{array}{r} 2 \\ 8\,\overline{)21} \\ -16 \\ \hline 5 \end{array} \qquad \begin{array}{r} 1 \\ 8\,\overline{)12} \\ -8 \\ \hline 4 \end{array}$$

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

$$\therefore \begin{array}{r} 417 \\ \times\ 134 \\ \hline {}^{1}2\,{}^{1}074 \\ {}^{1}14550 \\ +\,41700 \\ \hline (60544)_8 \end{array} \qquad \begin{array}{r} 1 \\ 8\,\overline{)12} \\ -8 \\ \hline 4 \end{array} \qquad \begin{array}{r} 1 \\ 8\,\overline{)13} \\ -8 \\ \hline 5 \end{array} \qquad \begin{array}{r} 1 \\ 8\,\overline{)8} \\ -8 \\ \hline 0 \end{array}$$

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

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

Ans to the ques no-08

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

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

Addition:

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

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

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

Subtraction:

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

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

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

Multiplication

$$\begin{array}{r} {}^{1}A\,3 \\ \times\ \ 7 \\ \hline 4\,7\,5 \end{array}$$

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

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

And,

$$\begin{array}{r} {}^{1}A\,3 \\ \times\ \ A \\ \hline 6\,5\,E \end{array}$$

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

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

$$\therefore \begin{array}{r} A\,3 \\ \times A\,7 \\ \hline {}^{1}4\,7\,5 \\ +6\,5\,E\,0 \\ \hline (6\,A\,5\,5)_{16} \end{array}$$

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

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

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

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

Ans to the ques no-09

$(-12345)_{10} = (?)_{1s}$ 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:

$(1100\ \ 1111\ \ 1100\ 0110)_{1s} = (-12345)_{10}$

Ans to the ques no - 10

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

Ans:

$(2)_{10}$ in binary

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

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

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.

$(01010101)_2 = (1010\ 1010)_{1s}$

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

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

$= (85)_{10}$.

$\therefore (10101010)_{1s} = (-85)_{10}$ (Ans)

Ans to the ques no-012

Given,

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

Inverting the given bits,

01000011

Adding +1,

$$\begin{array}{r} \overset{1}{0}\,\overset{1}{1}\,0000\,11 \\ +\ 1 \\ \hline (01000100)_2 \end{array}$$

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

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,

$(-120)_{10}$

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

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

$$\begin{array}{r|l l} 2 & 120 & \\ 2 & 60 & 0 \\ 2 & 30 & 0 \\ 2 & 15 & 0 \\ 2 & 7 & 1 \\ 2 & 3 & 1 \\ 2 & 1 & 1 \\ & 0 & 1 \end{array}$$

$$\therefore (-120)_{10} = \begin{array}{r} (10000111) \\ +\quad 1 \\ \hline (10001000)_{2s} \end{array}$$

<u>Ans to the ques no-14</u>

As per question;

$$91 - 499$$

$$= 91 + (-499)$$

Now,

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

Extending upto 10 bits, we get,

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

$$\begin{array}{r|ll} 2 & 91 & \\ 2 & 45 & 1 \\ 2 & 22 & 1 \\ 2 & 11 & 0 \\ 2 & 5 & 1 \\ 2 & 2 & 1 \\ 2 & 1 & 0 \\ & 0 & 1 \end{array} \uparrow$$

Now,

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

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

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

$$\begin{array}{r|ll} 2 & 499 & \\ 2 & 249 & 1 \\ 2 & 124 & 1 \\ 2 & 62 & 0 \\ 2 & 31 & 0 \\ 2 & 15 & 1 \\ 2 & 7 & 1 \\ 2 & 3 & 1 \\ 2 & 1 & 1 \\ & 0 & 1 \end{array} \uparrow$$

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

$$\begin{array}{r} 0001011011 \\ +\ 1000001100 \\ \hline (1001100111)_2 \end{array}$$

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

As per question;
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 : $+ \quad 1$

$11\ 1111\ 1111$

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

Now, Adding,

$$\begin{array}{r} 01\ 1111\ 1111 \\ +\ 11\ 1111\ 1111 \\ \hline \text{extra carry} \leftarrow 1\ 01\ 1111\ 1110 \\ +\quad 1 \\ \hline 01\ 1111\ 1111 \end{array}$$

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 $= (1C2)_{16} = 1 \times 16^2 + 12 \times 16 + 2 = (450)_{10}$ \$

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

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 $= (4064)_8 = 4 \times 8^3 + 0 + 6 \times 8^1 + 4 \times 8^0$

$= 2100$ \$

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

$= 0$ \$.

"Thanks THDS"