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Digital Logic Design

Assignment # 01

CH # 01

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Section: 'A'

— (1.2) —

Exact number of bytes = ?

a) $\boxed{16K \text{ bytes}}$

$= 16 \times 2^{10}$ bytes

$= 16,384$ bytes exactly

$1K = 2^{10} = 1024$

$1M = 2^{20} = 1024K$

$1G = 2^{30} = 1024M$

b) $\boxed{32M \text{ bytes}}$

$= 32 \times 2^{20}$ bytes

$= 33,554,432$ bytes

c) $\boxed{2G \text{ bytes}}$

$= 2 \times 2^{30}$ bytes

$= \cancel{2,147,483,648}$

$= 2,147,483,648$

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(2)

— (1.4) —

Largest binary number in 12 bits ⇒ $(1111\ 1111\ 1111)_2$

(1) Decimal:

4096 2048 1024 512 256 128 64 32 16 8 4 2 8190

1 1 1 1 1 1 1 1 1 1 1 1

$= 1\times2^{11}+1\times2^{10}+1\times2^{9}+1\times2^{8}+1\times2^{7}+1\times2^{6}+1\times2^{5}+1\times2^{4}+1\times2^{3}+1\times2^{2}$
$+1\times2^{1}+1\times2^{0}$

$= 2048+1024+512+256+128+64+32+16+8+4$
$+2+1$

$=(4095)_{10}$

(2) Octal:

4 2 1	4 2 1	4 2 1	4 2 1
1 1 1	1 1 1	1 1 1	1 1 1
7	7	7	7

$=(7777)_8$

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(3) Hexadecimal:

8 4 2 1	8 4 2 1	8 4 2 1
1 1 1 1	1 1 1 1	1 1 1 1
15	15	15

⇒ FFF

3

— (1·6) —

Given quadratic equation:

$$x^2 - 13x + 22 = 0 \quad \text{—} ① \quad , \quad x = 7 \ \& \ x = 2$$

base = ?

$$(x-7)(x-2) = 0$$

$$x^2 - (2+7)x + 14 = 0 \quad \text{—} ②$$

Compare equation ① & ② in terms of bases

$$2 + 7 = 3 + b$$

$$9 = 3 + b$$

$$\boxed{b = 6}$$

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So, the base is '6'

— (1·8) —

Convert decimal number 253 to $(-)_2$ by

a) Directly

2	253
2	126 − 1
2	63 − 0
2	31 − 1
2	15 − 1
2	7 − 1
2	3 − 1
	1 − 1

$\Rightarrow (11111101)_2$

(4)
b) Indirectly:
Decimal → Hexa → binary

$$16 \,|\, 253 \quad 15 - 13$$

$\Rightarrow 15\ 13 = FD$

	8	4	2	1
15	1	1	1	1
13	1	1	0	1

2 | 1513
2 | 756 - 1
2 | 378 - 0
  | 189 -

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$FD \Rightarrow (11111101)_2$

The direct method is faster because only one conversion is required.

— (1·10) —

Convert binary → hexadecimal & decimal

a) $(1.00011)_2 \rightarrow$ Decimal

$= 1\times 2^0 \cdot 0\times 2^{-1} + 0\times 2^{-2} + 0\times 2^{-3} + 1\times 2^{-4} + 1\times 2^{-5}$

$= 1\times 2^0 \cdot 0\times 2^{-1} + 0\times 2^{-2} + 0\times 2^{-3} + 1\times 2^{-4} + 1\times 2^{-5}$

$= 1.(0 + 0.25 + 0 + 0.0625 + 0.03125)$ 0.34375

$\boxed{= 1.34375}$

$(1.00011)_2 \rightarrow$ Hexadecimal

$$\underbrace{\overset{8\,4\,2\,1}{0001}}_{1} . \underbrace{\overset{8\,4\,2\,1}{0001}}_{1}\ \underbrace{\overset{8\,4\,2\,1}{1000}}_{8}$$

$\boxed{\Rightarrow (1.18)_{16}}$

(5)

b) $(1000.11)_2 \rightarrow$ Decimal

$= 1\times2^{3} + 0\times2^{2} + 0\times2^{1} + 0\times2^{0} \cdot 1\times2^{-1} + 1\times2^{-2}$

$= 8 + 0 + 0 + 0 \cdot (0.5 + 0.25)$

$\boxed{= (8.75)_{10}}$

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$(1000.11) \rightarrow$ Hexadecimal

$\underbrace{\overset{8}{1}\overset{4}{0}\overset{2}{0}\overset{1}{0}}\cdot\underbrace{\overset{8}{1}\overset{4}{1}\overset{2}{0}\overset{1}{0}}$

$= 8.12$

$\boxed{\Rightarrow 8.C}$

A	10
B	11
C	12
D	13
E	14
F	15

Answers are same but in (b) the decimal is shifted to the right by 4 bits

$2^4 = 8$

(a) 1.343

(b) 8.75

By Comparing both we can easily see (b) in decimal is 8 times than (a) part.

6 (1.12)

Add and multiply

a) 1101 & 110

```
   1101
 +  110
 ------
  10011
```

Sum => 10011

```
    1101
   x 110
  ------
    0000
   1101x
  1101xx
 -------
 1001110
```

product => 1001110

b) D0 & 1F

```
   D0        D0
 + 1F      x 1F
 ----     -----
   EF      1230
           D0x
          -----
           1930
```

A 10
B 11
C 12
D 13
E 14
F 15

13
15
195

16 | 195
12 - 3

1930

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(1.14)

Find 1's & 2's Complement

a) 11100010

$\boxed{1's = 00011101}$

2's = 00011101
+ 1
00011110

$\boxed{2's = 00011110}$

b) 00011000

$\boxed{1's = 11100111}$

11100111
+ 1

2's = 11101000

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c) 10111101

1's => 01000010

01000010
+ 1

2's => 01000011

d) 10100101

1's = 01011010

01011010
+ 1

2's => 01011011

e) 11000011

1's => 00111100

00111100
+ 1

2's => 00111101

f) 01011000

1's = 10100111

10100111
+ 1

2's => 10101000

8

— (1.16) —

a) Find 8's Complement of $(1740)_8$

$$
\begin{array}{r}
7\ 7\ 7\ 7 \\
1\ 7\ 4\ 0 \\
\hline
6\ 0\ 3\ 7 \\
+\ 1 \\
\hline
6\ 0\ 4\ 0 \\
\hline
\end{array}
$$

$8 \overline{\big|\, 8}$
$\ \ \ 1 - 0$

b) $(1740)_8 \rightarrow$ binary

	4	2	1
1	0	0	1
7	1	1	1
4	1	0	0
0	0	0	0

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$\Rightarrow (001111100000)_2$

c) 2's Complement of $(001111100000)_2$

1's = 110000011111

$+1$

2's $\Rightarrow$ 110000100000

d) convert (c) to octal & compare

421	421	421	421
110	000	100	000
6	0	4	0

$\Rightarrow (6040)_8$

10 Pg

—(1.28)—

Substract, take 2's complement if necessary of unsigned binary numbers.

a) 11001 − 10010

↓

1s = 01101

+1

2's → 01110

carry discard

11001

+01110

00111

11001 − 10010 ⇒ 00111 (+ive)

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b) 1100 − 111100

↓

1s → 000011

+1

2's → 000100

1100

+000100

010000

1100 − 111100 ⇒ 010000

(11)

c) 10101 − 11011

↓

1's → 00100

+1

2's → 00101

10101

+ 00101

∴(−ive) 11010

↓

00101

+1

2's → 00110

10101 − 11011 => −00110

d) 1100011 − 1001

↓

01110

+1

2's → 01111

1100011

+ 01111

∴ −ive 1110010

↓

0001101

+1

0001110

1100011 − 1001 => − 0001110

(11) (1.20)

+49 & +29 to binary with signed 2's Complement:

	32	16	8	4	2	1
+49	1	1	0	0	0	1

$= \underbrace{0}_{\text{sign}}\underbrace{110001}_{\text{magnitude}}$

−49

1's → 1001110

+1

2's → 1001111 => −49

+29

	16	8	4	2	1
0	1	1	1	0	1

$\underbrace{0}_{\text{sign}}\underbrace{11101}_{\text{magnitude}}$

+29 = 0 11101

−29 => 100010

+1

2's → 100011 = −29

(1) (+29) + (−49)

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sign

```
 0011101
 1001111
--------
 1101100
--------
  010011
      +1
--------
 1010100
```

(+29)+(−49) = 1010100 = −20

(2) (-29)+(+49)

11 100011
+ 0 110001

1 010100
discard

(-29)+(+49) => 1010100

(3) (-29)+(-49)

11 100011
11 001111

10 110010

1 001101
+1

2's -> 1001110

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-29+(-49) => 1001110 => -78

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(1.22)

Convert 9045 & 337 to BCD & ASCII

	9	0	4	5
BCD =	1001	0000	0100	0101

	9	0	4	5
	+30	+30	+30	+30
ASCII =>	39	30	34	35
	00111001	00110000	00110100	00110101

$\underbrace{00111001 \quad 00110000 \quad 00110100 \quad 00110101}_{\text{ASCII-Code}}$

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ASCII = 00111001001100000011010000110101

Even Parity => 1001110010011000000110100000110101

(1.24)

Formulate to binary table:

a) 6, 3, 1, 1

	6	3	1	1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	1
3	0	1	0	0
4	0	1	1	0
5	0	1	1	1
6	1	0	0	0
7	1	0	1	0
8	1	0	1	1
9	1	1	0	0

b) 6, 4, 2, 1

	6	4	2	1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	1	0	0	0
7	1	0	0	1
8	1	0	1	0
9	1	0	1	1

(1.26)

Find 9's complement of 2,231 & express in 2421.

$$\begin{array}{r} 9\,9\,9\,9 \\ -\;2\,2\,3\,1 \\ \hline 7\,7\,6\,8 \\ \hline \end{array}$$

	2	4	2	1
7	0	1	1	1
7	0	1	1	1
6	0	1	1	0
8	1	1	1	0

=> 0111 0111 0110 1110

(15)

(1.28)

"Pass 0.12" → ASCII code

P = 1010000

a = 110 0001

s = 111 0011

s = 111 0011

space = 32 = 1010 0000

0 = 0000000

. = 46 = 0101110

1 = 0000001

2 = 0000010

P	a	s	s	space	0
1010000	1100001	1110011	1110011	0100000	0000000

.	1	2
0101110	0000001	0000010

16

(1.30)

47 2E 5C 42 CF CF CC C5

47 = 0101111 = / = odd parity

2E = 0100010 = " = Even parity

5C = 100000000 = @ = odd parity

42 = 0101010 = * = odd parity

CF = 1100111 = g = Even parity

CF = 1100111 = g = Even parity

CC = 1100110 = f = Even parity

C5 = 11000101 = b = Even parity

Decoded ASCII = /"@*ggfb

(1.32)

'6' complimented bit to the right is needed to change capital to lowercase

Example:

D = 100 0100

d = 110 0100

So, '6' is complimented.

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(1.34)

List 10 ASCII bits 0-9

			Even	odd
0	= 48	= 110000	= 0110000	= 1110000
1	= 49	= 110001	= 1110001	= 0110001
2	= 50	= 110010	= 1110010	= 0110010
3	= 51	= 110011	= 0110011	= 1110011
4	= 52	= 110100	= 1110100	= 0110100
5	= 53	= 110101	= 0110101	= 1110101
6	= 54	= 110110	= 0110110	= 1110110
7	= 55	= 110111	= 1110111	= 0110111
8	= 56	= 111000	= 1111000	= 0111000
9	= 57	= 111001	= 0111001	= 1111001

The End

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