Logic Design:-

Mano

Ch1

1.1

16 → 32

Decimal	Binary	octal	hex
16	10000	20	10
17	10001	21	11
18	10010	22	12
19	10011	23	13
20	10100	24	14
21	10101	25	15
22	10110	26	16
23	10111	27	17
24	11000	30	18
25	11001	31	19
26	11010	32	1A
27	11011	33	1B
28	11100	34	1C
29	11101	35	1D
30	11110	36	1E
31	11111	37	1F
32	100000	40	20

For easy you can convert First to Binary ex.

16	2	
8	2	0
4	2	0
2	2	0
1	2	0
0		1

$\rightsquigarrow (16)_{10} = (10000)_2$

and then convert from Binary to Octal By substit every 3 bit to its value in octal

so $(16)_{10} = (10000)_2 = (20)_8$

& convert to hex by substituting every 4 bits to its value in hex

$(16)_{10} = (10000)_2 = (10)_{16}$

⇒ or convert Directly to octal & hex

16	8	
2	8	0
0		2

⇒ $(16)_{10} = (20)_8$

16	16	
1	16	0
0		1

$= (10)_{16}$

⇒ Convert to Base 13 → 0, 1, 2, ... 9, A, B, C

Decimal	Base 13
8	8
9	9
10	A
11	B
12	C
13	10
14	11
15	12
16	13
17	14
18	15
19	16
20	17
21	18
22	19
23	1A
24	1B
25	1C
26	20
27	21
28	22

13	13	
1	13	0
0		1

22	13	
1	13	9
0		1

23	13	
1	13	A
0		1

16	12
4	12

1
4

23	13
1	13
0	

10 = A

1

55 - 32 = 23
= 16
= 7

$\overset{5\,4}{110111}$

1.2

1 Kilo bytes = 1024 bytes
1 Mega " = 1024 * 1024 bytes
1 Giga " = 1024 * 1024 * 1024 bytes

a) 32K = 32 * 1024 = 32768 bytes
b) 64M = 64 * 1024 * 1024 = 67,108,864 bytes
c) 6.4G = 6.4 * 1024 * 1024 * 1024 = 6,871,947,674 bytes

1.3 Convert to Decimal

a) $(4310)_5 = 4*5^3 + 3*5^2 + 1*5^1 =$

b) $(198)_{12} = 1 \times 12^2 + 9 \times 12^1 + 8 \times 12^0 =$

c) $(735)_8 = 7 \times 8^2 + 3 \times 8^1 + 5 \times 8^0 =$

d) $(525)_6 = 5 \times 6^2 + 2 \times 6^1 + 5 \times 6^0 =$

To convert from any base to decimal Multiply each number by base with power of The position of The number.

1.4 largest number can be expressed in 14 bits

$(11111111111111)_2 = 2^{14} - 1 = (16383)_{10} = (3FFF)_{16}$

1.5 Determine the base :-

let base is "b" any number that give 1 concatinated with other number [as we convert to Decimal]

a) $14/2 = 5 \Rightarrow \dfrac{1 \times b^1 + 4 \times b^0}{2 \times b^0} = 5 \times b^0$

$= \dfrac{b+4}{2} = 5 \Rightarrow b + 4 = 10 \Rightarrow \boxed{b = 6}$

b) $\frac{54}{4} = 13 \Rightarrow \frac{5\times b^1 + 4\times b^0}{4\times b^0} = 1\times b^1 + 3\times b^0$

$\Rightarrow \frac{5b+4}{4} = b+3 \Rightarrow 5b+4 = 4b+12$

$\Rightarrow \boxed{b=8}$

c) $24 + 17 = 40 \Rightarrow$

$2\times b^1 + 4\times b^0 + 1\times b^1 + 7\times b^0 = 4\times b^1 + 0\times b^0$

$2b + 4 + b + 7 = 4b + 0$

$3b + 11 = 4b$

$\boxed{b = 11}$

1.6

$x^2 - 11x + 22 = 0$

Sol $x = 3$ & $x = 6$

$x^2 - (1\times b + 1)x + (2\times b + 2) = (x-3)(x-6)$

$x^2 - (b+1)x + (2b+2) = x^2 - 3x - 6x + 18$

$= x^2 - 9x + 18$

$\therefore b+1 = 9$ & $2b+2 = 18$

$\boxed{b = 8}$ or $2b = 16 \Rightarrow \boxed{b=8}$

1.7 Convert to Binary & then to octal

$(68BE)_{16} = (0110\_1000\_1011\_1110)_2 = (064276)_8$

1.8 convert to Binary. 431

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

a) Dec → Bin

431	2	
215	2	1
107	2	1
53	2	1
26	2	1
13	2	0
6	2	1
3	2	0
1	2	1

$\Rightarrow (110101111)_2$

b) Dec → hex

431	16	
26	16	15
1	16	10
0		1

$(431)_{10} = (1AF)_{16} = (0001\_1010\_1111)$

faster less calculation

1.9 convert to Decimal

a) $(10110.0101)_2 = 1\times2^4 + 1\times2^2 + 1\times2^1 + 1\times2^{-2} + 1\times2^{-4} =$

b) $(16.5)_{16} = 1\times16^1 + 6\times16^0 + 5\times16^{-1} =$

c) $(26.24)_8 = 2\times8^1 + 6\times8^0 + 2\times8^{-1} + 4\times8^{-2} =$

d) $(FAFA)_{16} = 15\times16^3 + 10\times16^2 + 15\times16^1 + 10\times16^0 =$

e) $(1010.1010)_2 = 1\times2^3 + 1\times2^1 + 1\times2^{-1} + 1\times2^{-3} =$

1.10 convert to hex & Dec

a) $(1.10010)_2 = (1.90)_{16} = 1\times16^0 + 9\times16^{-1} = (1.5625)_{10}$

$1 + \frac{9}{16}$

b) $(110.010)_2 = (6.4)_{16} = 6\times16^0 + 4\times16^{-1} = (6.25)_{10}$

$6 + \frac{4}{16}$

$(4 * 1.5625) = 6.25$

→ By shifting 1 bit to left it mean multiply by 2

shift by 2 bit multiply by 4

→ shift to Right divide by 2

1.11 Divide

```
        001011.11001
101 ) 111011.000
      101
      01001
        101
      01001
        101
        1000
         101
        00110
          101
        001000
            101
           0011
```

in decimal

```
   11.81
5 ) 59
    5
    09
```

```
   1001
101 ) 1110
      101
      111
      101
      0100
```

```
 4 12
 6152
 2043 -
 4109
```

```
 1
 2043
 3848 +
 5891
```

```
      00101.
101 ) 111011
      101
      01001
        101
        1001
         101
      101000
      100001
      10111111
```

```
      1011.110
101 ) 111011
      101
      1001
       101
       1001
        101
        1000
         101
```

0110

1.12 ADD & multiply

a)

$$\begin{array}{r} 1011 \\ 101\times \\ \hline 1011 \\ 0000 \\ 1011 \\ \hline 110111 \end{array} \qquad \begin{array}{r} 1011 \\ 101+ \\ \hline 10000 \end{array}$$

b)

$$\begin{array}{r} 2E \\ 34\times \\ \hline B8 \\ 8A \\ \hline (958)_{16} \end{array}$$

$\rightarrow$ $E \times 4 = (56)_{10} \rightarrow (38)_{16}$

56 | 16
3 | 16
0

8
3

$E \times 3 = (42) \rightarrow (2A)_{16}$

42 | 16
2 | 16
0

A
2

5 4 3
111000
38
101010
2A

$$\begin{array}{r} 2E \\ 34+ \\ \hline (62)_h \end{array}$$

1.13 a) convert to Bin

$(27.315)_{10}$

27	2	
13	2	1
6	2	1
3	2	0
1	2	1
0		1

$(11011)_2$

11011

$0.315 * 2 = 0.630$ 0
$0.630 * 2 = 1.260$ 1
$0.260 * 2 = 0.520$ 0
$0.520 * 2 = 1.040$ 1

$(.0101)$

$(27.315)_{10} = (11011.0101)_2$

b) $2/3 = 0.66666667$

$0.66666667 * 2 = 1.33333333$ 1
$0.33333333 * 2 = 0.66666667$ 0
$0.66666667 * 2 = 1.333$ 1
$0.333 \times 2 = 0.6$ 0

$(0.66666667)_{10} = (0.10101010)_2 =$

c) $(0.10101010)_2 = (0.AA)_{16} = 10\times16^{-1} + 10\times16^{-2} = \frac{10}{16} + \frac{10}{256}$

$= 0.0625 +$

0.0039063

$= (0.6640625)_{10}$

1.14 1's & 2's complement

	a) 10000000	b) 00000000	c) 11011010	d) 01110110
1's	01111111	11111111	00100101	10001001
2's	10000000	00000000	00100110	10001010

e) 10000101	f) 11111111
01111010	00000000
01111011	00000001

1.15 9's & 10's

	a) 52,784,630	b) 63,325,600	c) 25,000,000	d) 00,000,000
9's	47,215,369	36,674,399	74,999,999	99,999,999
10's	47,215,370	36,674,400	75,000,000	00,000,000

1.16

a) 16's

15 15 15 16

$B2FA \xRightarrow{16's} 4D06$

b) $(B2FA)_{16} = (1011\_0010\_1111\_1010)_2$

c) 2's = 0100_1101_0000_0110 The Same as (b)

d) $(4D06)_{16}$

1.17

a) 6428 − 3409 → 06428 + 96591 = 103019

result is +ve remove the extra 1 and the answer is $\boxed{+3019}$

b) 00125 − 01800 → 00125 + 98200 = 98325 → extra digit is zero so the result is −ve find the 10's complement for the number $\boxed{-01675}$

c) 2043 − 6152 → 02043 + 93848 = 95891 → $\boxed{-04109}$

d) 1631 − 745 → 01631 + 99255 = 100886 → $\boxed{+886}$

1.18

a) 10011 − 10001 → 010011 + 101111 = $\boxed{1}$000010 → + $\boxed{00010}$

b) 100010 − 100011 → 0100010 + 1011101 = 1111111 → $\boxed{-0000001}$

c) 1001 − 101000 ⇝ 0001001 + 1011000 = 1100001 ⇝ $\boxed{-0011111}$

d) 110000 − 10101 ⇝ 0110000 + 1101011 = 10011011 ⇝ $\boxed{+\ 0011011}$

$\boxed{1.19}$

+9286 → 009286 → 10's = 990714

+801 → 000801 → 10's = 999199

The output must putted in 5 digits plus 1 digit for s

a) 009286 + 000801 = $\boxed{010087}$

b) 9286 − 801 ⇝ 009286 + 999199 = 1008485 ⇝ $\boxed{+\ 008485}$

c) −9286 + 801 ⇝ 990714 + 000801 = 991515 ⇝ $\boxed{-\ 008485}$

d) −9286 + −801 ⇝ 990714 + 999199 = 989913 ⇝ $\boxed{989913}$ = $\boxed{-\ 10087}$

$\boxed{1.20}$ +49 → $(0110001)_2$, +29 → 0011101

−49 → $(1001111)_2$, −29 → $(1100011)_2$

a) 29−49 = 0011101 + 1001111 = 1101100 → −0010100 = $\boxed{-20}$

b) −29+49 = 1100011 + 0110001 = 1 0010100 = + 0010100 = +20

c) −29−49 = 1100011 + 1001111 = 1 0110010

But to accomodate overflow make sign extension

note To identify firstly The required number of bits required to represent The number add The two number

$49+29 = 0110001 + 0011101 = 1001110$

so we need 7bit + 1bit For sign

$$-29 \rightarrow 11\_100011$$
$$+\ 11\_001111$$
$$10\_110010$$
$$\rightarrow \boxed{-\ 1001110} = \boxed{-78}$$

1.21 $+9,742 = 009,742$
$-9742 \rightarrow 990258$

$+641 \rightarrow 000641$
$-641 \rightarrow 999359$

a) $+9742 + 641 = 009742 + 000641 = \boxed{010383}$

b) $+9742 - 641 = 009742 + 999359 = \boxed{009101}$

c) $-9742 + 641 = 990258 + 000641 = 990899$
$= \boxed{-009101}$

d) $-9742 - 641 = 990258 + 999359 = 989617$
$= \boxed{-010383}$

1.22 8723

to convert to ASCII add to The decimal number 0011 0000 = 48 So It can be

يعني بنخلي ال 4 bit الاولانين

زي الرقم ع ال Binary وكده رابع

وال bit التانيين هما 0011 ثابتة

even parity

56 55 50 51

ASCII: 10111000 10110111 10110010 00110011

BCD: 1000 0111 0010 0011

1.23 842, 537 in BCD

$842 \rightarrow 1000\ 0100\ 0010$
$537 \rightarrow 0101\ 0011\ 0111$
1379

$$\begin{array}{r} 1000 \\ +0101 \\ \hline 1101 \\ +0110 \\ \hline 1\ 0011 \end{array} \qquad \begin{array}{r} 0100 \\ +0011 \\ \hline 0111 \end{array} \qquad \begin{array}{r} 0010 \\ 0111 \\ \hline 1001 \end{array}$$

So result is $\boxed{1379}$

in case the result is greater than 1001
we add +6 to the result to convert it to correct digit and also produce a carry

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1.24 Decimal digit from 0 to 9

a)

6	3	1	1	Dec
0	0	0	0	0
0	0	0	1	1 or (0010)
0	0	1	1	2
0	1	0	0	3
0	1	0	1	4 or (0110)
0	1	1	1	5
1	0	0	0	6
1	0	0	1	7 or (1010)
1	0	1	1	8
1	1	0	0	9

b)

6	4	2	1	
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
1	0	0	0	or (0
1	0	0	1	or (0111)
1	0	1	0	
1	0	1	1	

1.25 5137

a) BCD : 0101 0001 0011 0111

b) excess-3 : 1000 0100 0110 1010

c) 2421 : 1011 0001 0011 0111
(1011, 0101, 1001, or 1101)

d) 6311 : 0111 0001 0100 1001

1.26 5137 → 9's = 4862 → 0100 1110 1100 1000

5137, 2421 2421, 1's, 2421

1's ⇒ 1011 0001 0011 0111

نعبر الرقم ومتمثل بنظام 2421

وجبناله 1's هيطلع هو هو الرقم

The same as (c) in 1.25

<u>Self complemented</u> code is one that 9's comp in Dec is 1's comp in bin

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1.27 $(52)_{10}$ → 32 < 52 < 64

So we need 6 bits for encoding

diamonds
hearts
clubs
spades

00 01 10 11   0000   1 — 9 numbers

10 Jack

15 Queen

A
small = 32 + capital | الحروف
1101 100
0040
0011

48 + أرقام
0011

A
65
46

a
97

1.28 G.cBooLe

even parity if the number of 1's is odd add 1 else add zero
odd parity is visa versa

0100 0111 0010 1110 0100 0010 0110 1111 0110 1111 0110 0101
0010 0000

1.29 BiLLGates

1.30

odd

73	F4	E5	4A	EF	62
0111 0011	1111 0100	1110 0101	0100 1010	1110 1111	0110 0010
s	t	e	J	o	b
					73
					0111 0011
					s

76 E5
0111 0110 e
v

steve Jobs, odd parity

1.31 62 + 32
26 letter upper + 26 lower
10 Decimal Digits
32 special printable character
34 control char

$$26 + 26 + 10 + 32 = 62 + 32 = 94$$

1.32 A a
65 ⇒ 1000001 , 97 ⇒ 1100001
Bit 5

ASCII Small letter = ASCII Capital + 32
110 100

1.33

a) $(897)_{BCD}$

b) $(564)_{excess\ 3}$

c) $(897)_{8421}$ $\rightsquigarrow 2421$

d)

$$1000\ 1001\ 0111 = 2^{11} + 2^7 + 2^4 + 2^2 + 2^1 + 1$$
$$= 2199$$

1.34

$48 = 32 + 16$

0	10110000
1	00110001
2	00110010
3	10110011
4	00110100
5	10110101
6	10110110
7	00110111
8	00111000
9	10111001

1011 0000

0011 0001

0011 1001

$F = a \oplus b$

$g = (a \oplus b)'$

1.35

c	b	a	F	g
0	0	0	1	1
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	1	0
1	0	1	1	0
1	1	0	1	0
1	1	1	0	0

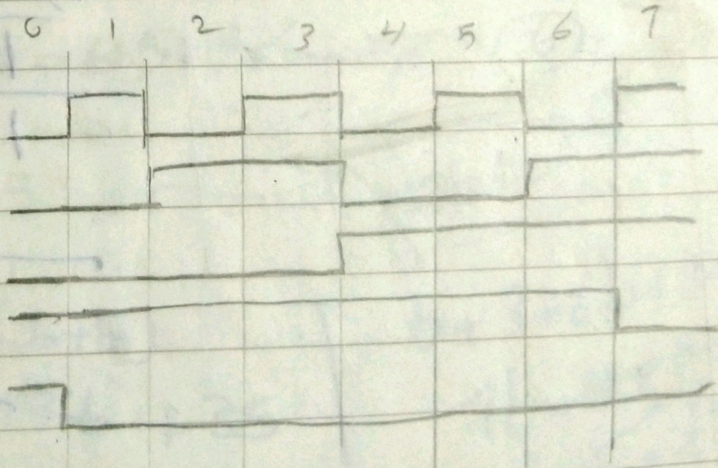
a

b

c

F

g



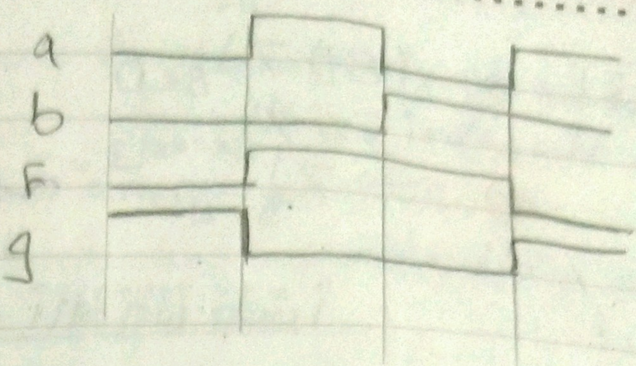
NAND

x	y	z
0	0	1
0	1	1
1	0	1
1	1	0

NOR

x	y	z
0	0	1
0	1	0
1	0	0
1	1	0

b a	F	g
0 0	0	1
0 1	1	0
1 0	1	0
1 1	0	1



A self complementing code:

is one that 9's Complement in decimal is the 1's complement in binary.

⇒ Prove that BCD is not self complemented code, But 2421 is Self complemted?

00 1011.11

1.01) 1110 11
101
0100 1
101
1001
101
1000
101
0110
101
001