HOMEWORK 1 – DUE ON OCTOBER 3

SOLUTIONS

1.23) a) **Sequential** : Since timing is involved and it has to go through a series of steps in a particular order

b) **Combinational** : No timing involved , just arithmetic operation

c) **Sequential** : again timing is involved here

d) **Combinational** : Here we can do a simple comparison operation to sound an alarm , which is combinational logic

e) **Combiational** : Simple AND gates can be used to do the logic

f) **Combinational** : This is nothing but XOR gate

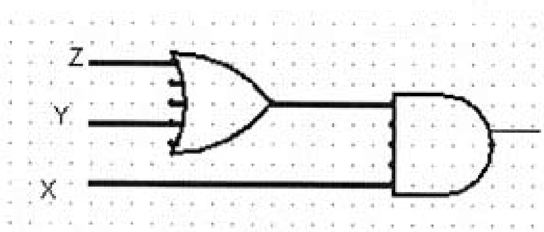
e) **Sequential** : Here again the bits needs to be buffered one after the other which requires sequential logic . (Note : an element of timing is there)

g) **Combinational** : This is a simple Decoder .

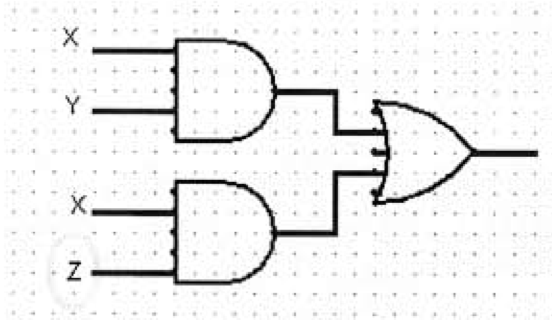
1.30) Just modify the State diagram in Pg 21 by drawing an arrow back from "Open" state to "S1" state after a delay for one clock cycle (Delays can be usually given by D – Flip Flops from hardware point of view) NOTE : D-Flip Flops will be dealt with later

2.2)

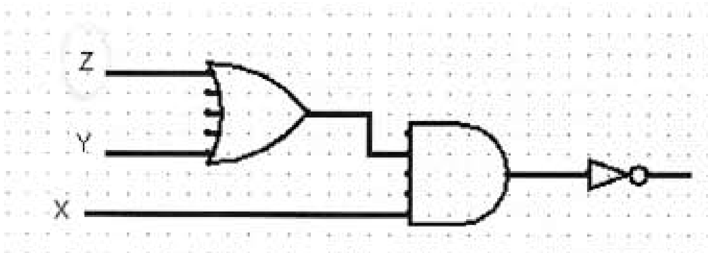
a) X(Y+Z)



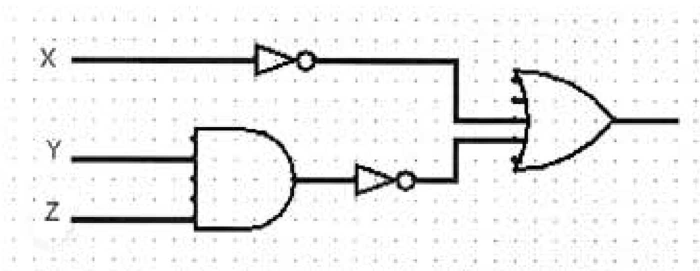
b) XY+XZ



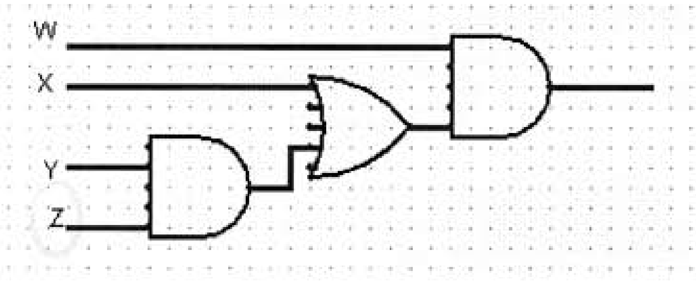
c) $\overline{X(Y+Z)}$



d) $\overline{X}+\overline{YZ}$



e) W(X+YZ)



2.6)

b) $X(X+Y) = XX + XY$

$= X+XY$

$= X(1+Y)$

$= X$

d) $(X+Y)(X'+Z) = XX'+XZ+YX'+YZ$

$= XZ+X'Y+YZ$

$= XZ+X'Y+YZ(X+X')$

$= XZ(1+Y) + X'Y(1+Z)$

$= XZ+X'Y$ (Consensus Theorem)

2.10)

b) $ABC + B(C'+D')$

$=[ABC+B.(C'+D')]'$

$=(ABC)'[B.(C'+D')]'$

$=(A'+B'+C')[B'+(C'+D')']$

$=(A'+B'+C')(B'+CD)$

g) $X(Y+ZW'+V'S)$

$=[X(Y+ZW'+V'S)]'$

$=X'+(Y+ZW'+V'S)'$

$=X'+[Y'.(ZW')'.(V'S)']$

$=X'+Y'(Z'+W)(V+S')$

APPENDIX PROBLEMS

A1) (c) $(0101011)_2 = (1\times2^5)+(1\times2^3)+(1\times2^1)+(1\times2^0)$

$= (43)_{10}$

(f) $(123)_8 = (1\times8^2)+(2\times8^1)+(3\times8^0)$

$= (83)_{10}$

(i) $3AE_{16} = (3\times16^2)+(10\times16^1)+(14\times16^0)$

$= (942)_{10}$

A2) (c) $(129)_{10} \rightarrow (\ \ )_2$

$$
\begin{array}{r|l}
2 & 129 \\
2 & 64 - 1 \\
2 & 32 - 0 \\
2 & 16 - 0 \\
2 & 8 - 0 \\
2 & 4 - 0 \\
2 & 2 - 0 \\
 & 1 - 0
\end{array}
$$

$\therefore (129)_{10} = (10000001)_2$

(f) $(798)_{10} \rightarrow (\ \ )_8$

$$
\begin{array}{r|l}
8 & 798 \\
8 & 99 - 6 \\
8 & 12 - 3 \\
 & 1 - 4
\end{array}
$$

$(798)_{10} = (1436)_8$

(ii) $(240)_{10} \rightarrow (\ )_{16}$

$$16 \,\underline{|240}$$
$$15 - 0$$

$(240)_{10} \rightarrow$ ~~$(F)_{16}$~~ $(F)_{16}$

A3) (i) 1001000111000101_2 to base 8

$= (1\times2^{15}) + (1\times2^{12}) + (1\times2^{8}) + (1\times2^{7}) + (1\times2^{6}) + (1\times2^{2}) + (1\times2^{0})$

$= 32768 + 4096 + 256 + 128 + 64 + 4 + 1$

$= (37317)_{10}$

Now

$$8 \,\underline{|37317}$$
$$8 \,\underline{|4664} - 5$$
$$8 \,\underline{|583} - 0$$
$$8 \,\underline{|72} - 7$$
$$8 \,\underline{|9} - 0$$
$$1 - 1$$

ANS $= (110705)_8$

(ii) 11100011001100011000_2 to base 16

$= (1\times2^{19}) + (1\times2^{18}) + (1\times2^{17}) + (1\times2^{13}) + (1\times2^{12}) + (1\times2^{9}) + (1\times2^{8})$
$+ (1\times2^{4}) + (1\times2^{3})$

$= (930584)_{10}$

$$\begin{array}{r|l} 16 & 930584 \\ 16 & 58161 - 8 \\ 16 & 3635 - 1 \\ 16 & 227 - 3 \\ & 14 - 3 \end{array}$$

$\therefore \ = (E3318)_{16}$.

A4) (c) $(101)_8 \rightarrow (1\times8^2) + (1\times8^0)$

$= (17)_{10}$

Now

$$\begin{array}{r|l} 2 & 17 \\ 2 & 8 - 1 \\ 2 & 4 - 0 \\ 2 & 2 - 0 \\ & 1 - 0 \end{array}$$

$(101)_8 = (10001)_2$

(b) $(8FC)_{16} \rightarrow (8\times16^2) + (15\times16^1) + (12\times16^0)$

$= 2048 + 240 + 12 = (2300)_{10}$

Now

$$\begin{array}{r|l} 2 & 2300 \\ 2 & 1150 - 0 \\ 2 & 575 - 0 \\ 2 & 287 - 1 \\ 2 & 143 - 1 \\ 2 & 71 - 1 \\ 2 & 35 - 1 \\ 2 & 17 - 1 \\ 2 & 8 - 1 \\ 2 & 4 - 0 \\ 2 & 2 - 0 \\ & 1 - 0 \end{array}$$

$\therefore (8FC)_{16} = (100011111100)_2$

A7) (c)

```
  111110 +
  101111
 -------
 1010101
```

(b)

```
  10101010 +
  01111111
 ---------
 100101001
```

A8) (d)

```
 111001 -
  10001
 ------
 101000
```

(e)

```
 11011100110 -
    10011001
 -----------
 11001001101
```

A9) (d) $(A9DE)_{16} \rightarrow (\ \ )_3$

$(A9DE)_{16} = (10\times16^3) + (9\times16^2) + (13\times16) + (14\times16^0)$

$= 40960 + 2304 + 208 + 14$

$= 43486$

$$
\begin{array}{r|l}
3 & 43486 \\
3 & 14495 - 1 \\
3 & 4831 - 2 \\
3 & 1610 - 1 \\
3 & 536 - 2 \\
3 & 178 - 2 \\
3 & 59 - 1 \\
3 & 19 - 2 \\
3 & 6 - 1 \\
 & 2 - 0
\end{array}
$$

$\therefore (A9DE)_{16} = (2012122121)_3$

(A11) (a) $-13 \rightarrow$ SIGN and MAGNITUDE (6 BITS)

$$
\begin{array}{r|l}
2 & 13 \\
2 & 6 - 1 \\
2 & 3 - 0 \\
 & 1 - 1
\end{array}
$$

$+13 = 001101$

$\therefore -13 = \boxed{1}01101$

SIGN BIT

A12) (b) $-27 \rightarrow$ ONE'S COMPLEMENT

$$
\begin{array}{r|l}
2 & 27 \\
2 & 13 - 1 \\
2 & 6 - 1 \\
2 & 3 - 0 \\
 & 1 - 1
\end{array}
$$

$+27 = 011011$

$-27 = 100100 \rightarrow$ One's Complement

A13) (c) $-5 \rightarrow 2's$ COMPLEMENT

$+5 \rightarrow 000101$

$-5 = 111011$ in 2's COMPLEMENT

1.3) (1) Direct Sequence Binary Encoding : To represent 52 cards we need 6 bits . Each card can be directly encoded in an order (Some extra combinations may not be used as with 6 bits we get 64 combinations but we need only 52 of them)

(2) Use 2 bits to encode which class of card a particular card belongs to ((ie.) spades , hearts etc.) Then 4 bits to represent the card it refers to in that class . [to represent 13 cards in each class we need atleast 4 bits , though some combinations may not be used here also] eg: 00 0010 – the Most significant 2 bits “00” can refer to spade and the remaining 4 bits can refer to a particular card in spade .

NOTE : Omit 1.30) in solution set as it is not included in HW1