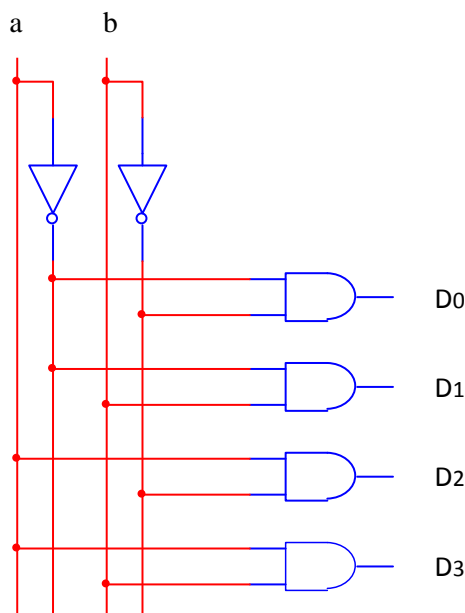# DECODER

A Decoder is a combinational circuit that converts binary information from n input lines to a maximum of $2^n$ unique O/P lines.

The Truth Table for a two - input ( four - output ) decoder is shown below :

The decoder consist of an ANDgate for each output , plus NOTgate to invert the Input

| a | b | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|
| 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | 1 |

The block diagram is given below output 0 is just ($\overline{a}\,\overline{b}$) , output 1 is ($\overline{a}\,b$) and output 2 is ($a\,\overline{b}$) and output 3 is ($a\,b$) . Each output corresponds to one of minterms for a two - variable



More decoder also have one or more enable inputs . When such input is active ,the decoder behaves as described . When it is in active , all of the outputs of the decoder are in active . In most system with a sing le enable ( not just decoder),that input is active low
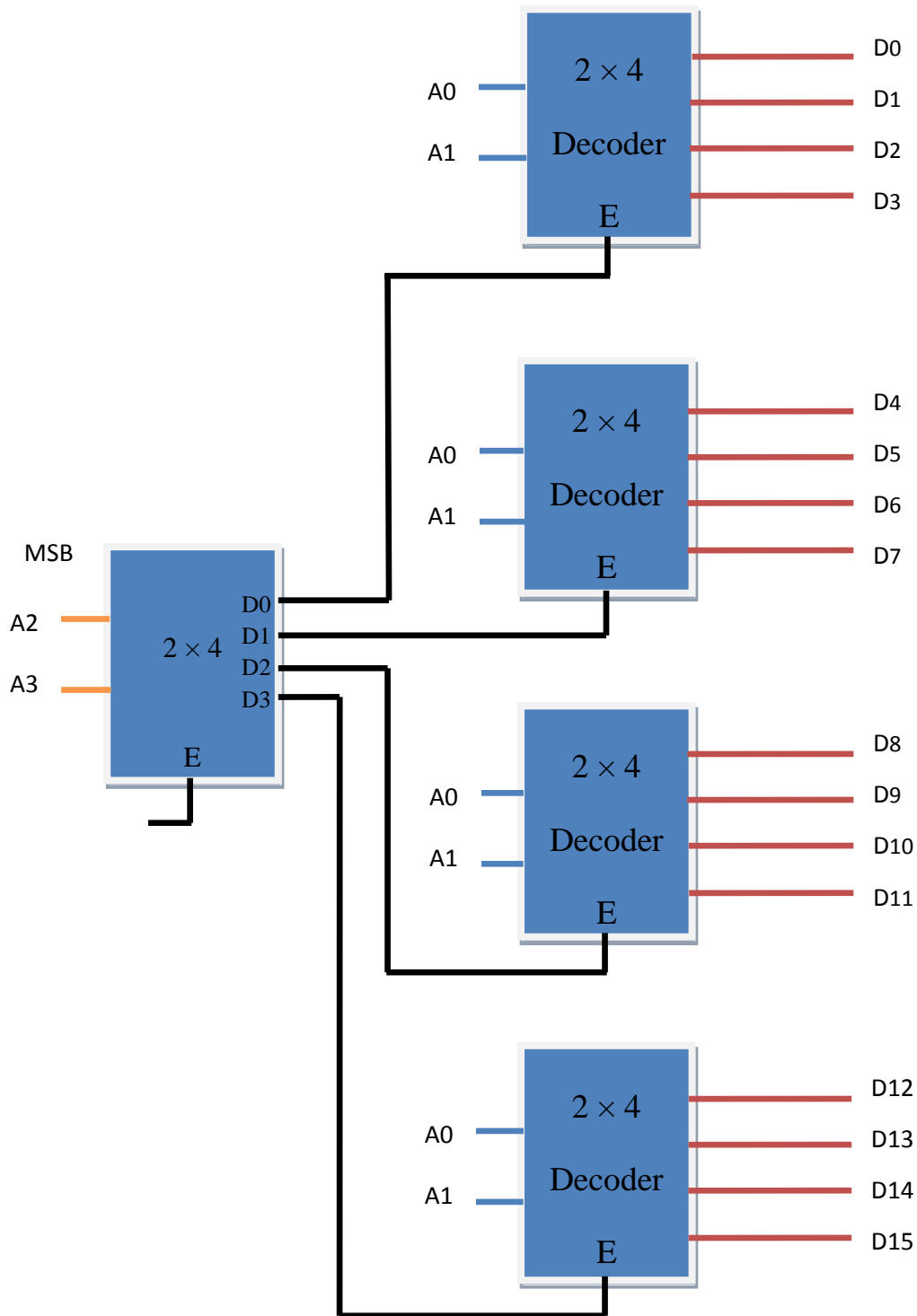
| E | a | b | D0 | D1 | D2 | D3 |
|---|---|---|----|----|----|----|
| 1 | x | x | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 | 0 | 1 |
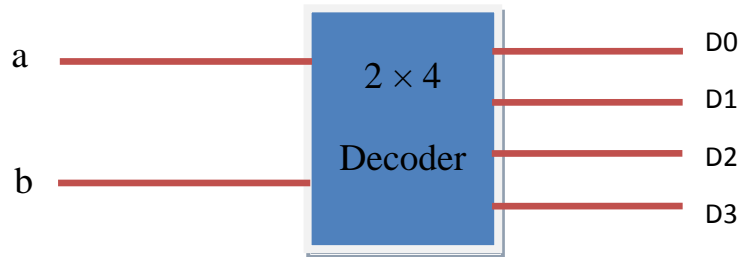


Ex / Use two $3 \times 8$ decoder with enable input to form a 4 - bit to 16 line decoders
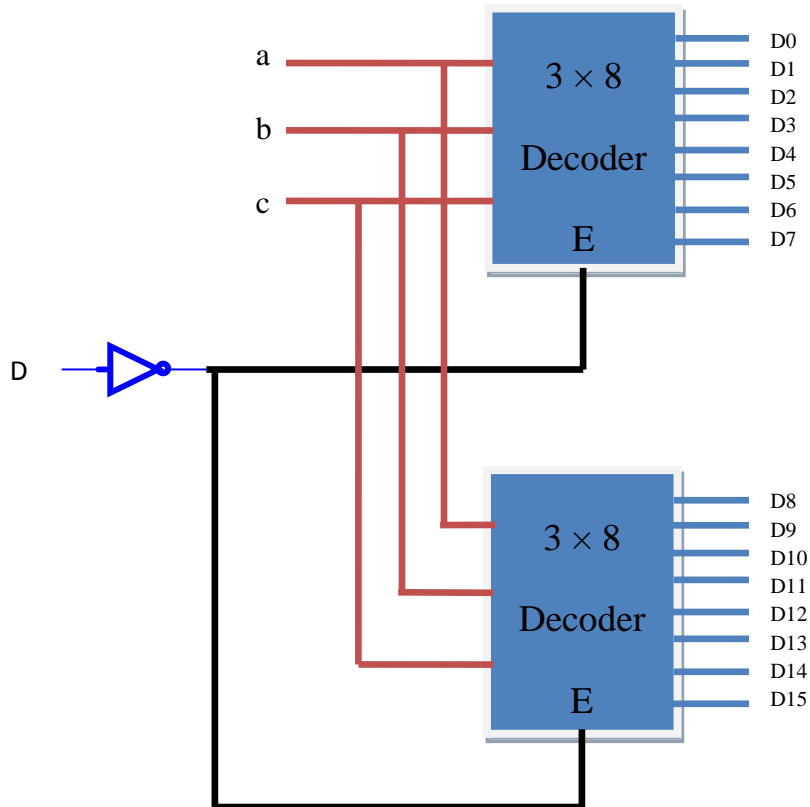
Ex / Construct 4 - to - 16 decoder with an enable input using five 2 - to - 4 line decoder with enable inputs.

Ex / A combinational circuit is defined by the following three Boolean functions.

$$F1 = \overline{x+y} + xy\bar{z}$$
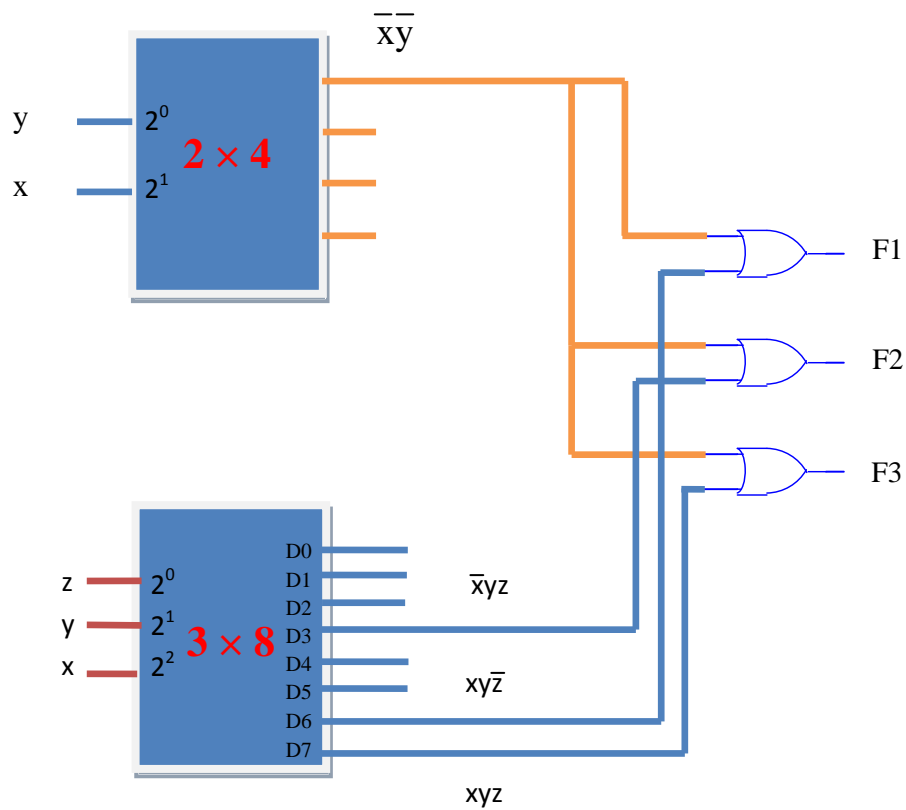
$$F2 = \overline{(x+y)} + \bar{x}yz$$

$$F3 = \overline{(x+y)} + xyz$$

sol /

$F1 = \bar{x}\bar{y} + xy\bar{z}$
$F2 = \bar{x}\bar{y} + \bar{x}yz$
$F3 = \bar{x}\bar{y} + xyz$

# SEVEN - SEGMENT DECODERS:

Figure A , shows a seven segment indicator , i.e , seven LEDs labeled a through g .
By forward - biasing different LEDs , we can display the digit 0 through 9 (see figure B )
For instance to display a 0, we need to light up segments a,b,c,d,e and f . To light up a 5,
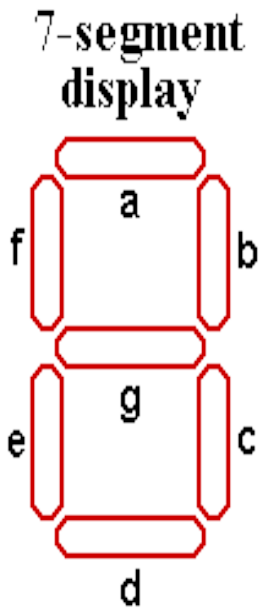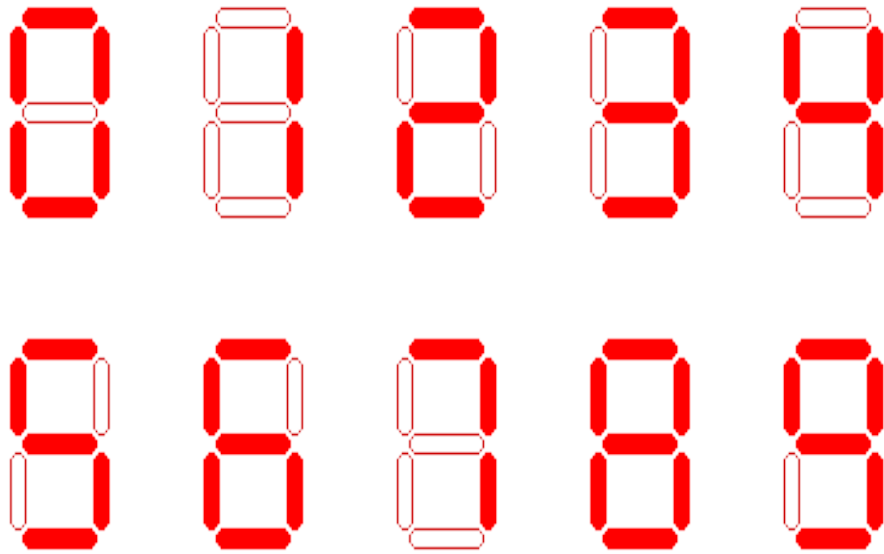We need segments a,b,c,d,f and g.



Figure A

Figure B

# ENCODER

An Encoder is a digital circuit that performs the inverse operation of a decoder . An Encoder has ( $2^n$ ) (or fewer ) input lines and (n) output lines . The output lines generate binary code corresponding to the input value .

| Input | | | | | | | | Output | | |
|-----|-----|-----|-----|-----|-----|-----|-----|---|---|---|
| D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | A | B | C |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |

D1
D3
D5
D7
C

D2
D3
D6
D7
B

D4
D5
D6
D7
A
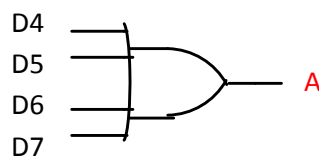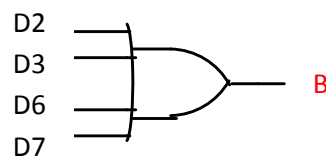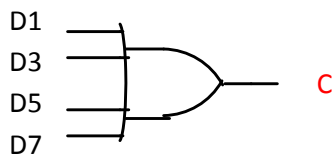
NOTE : Since n Input decoder generates all the minterms of n variables , or generates all the maxterms, function can be relized by ORing selected minterms or ANDing selected maxterms .