Combinational logic circuits

Combination circuit is a logic circuit in which the output at any time depends on the present inputs without regard to previous outputs.

Design Procedure:

Step1:- Determine the number of inputs available and number of outputs required.

Step2:-Assign the latter symbols to all the inputs and outputs.

Step3:-Develop a truth table.

Step4:-Obtain the Boolean expressions for all the outputs and simplify using k-map.

Step5:-Draw the logic diagram.

Ex: Design of 3-bit squarer circuit

Sol:- The maximum value of 3 bit is 111, which is 7 in decimal.

square of 7 is 49

To represent 49 in binary, 6 bits are required i.e., 49=110001

let inputs are x_2, x_1, x_0 and outputs $y_5, y_4, y_3, y_2, y_1, y_0$

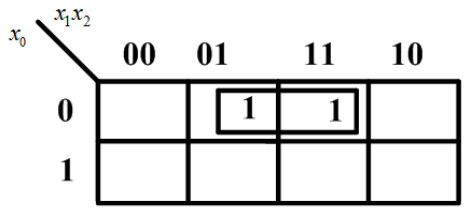
Truth table:

x_2	x_1	x_0	y_5	y_4	y_3	y_2	y_1	y_0
0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	1
0	1	0	0	0	0	1	0	0
0	1	1	0	0	1	0	0	1
1	0	0	0	1	0	0	0	0
1	0	1	0	1	1	0	0	1
1	1	0	1	0	0	1	0	0
1	1	1	1	1	0	0	0	1

From the truth table

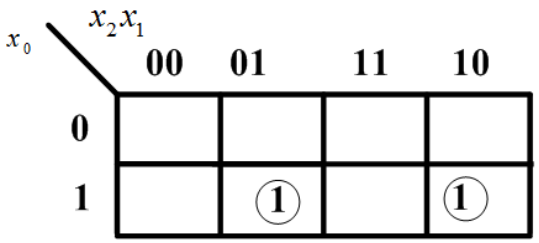
$$y_0 = x_0 \; ; y_1 = x_1$$

$$y_2 = \sum m(2,6)$$



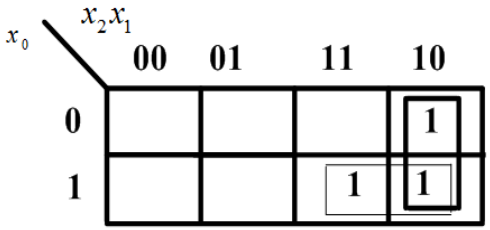
$$\therefore y_2 = x_1\overline{x_0}$$

$$y_3 = \sum m(3,5)$$



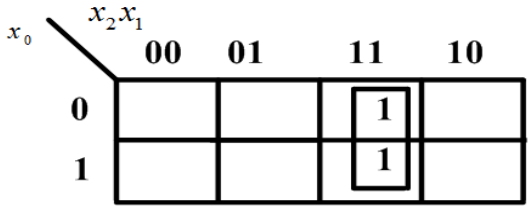
$$\therefore y_3 = \overline{x_2}x_1x_0 + x_2\overline{x_1}x_0$$
$$= x_0(x_1 \oplus x_2)$$

$$y_4 = \sum m(4,5,7)$$



$$\therefore y_4 = x_2\overline{x_1} + x_2x_0$$

$$y_5 = \sum m(6,7)$$



$$\therefore y_5 = x_2x_1$$

Logic diagram:-