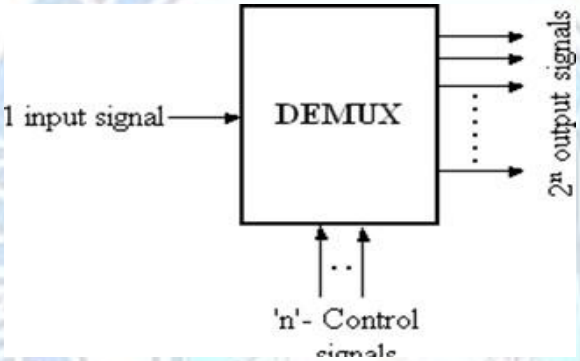
DEMULTIPLEXER

Demultiplexer means one into many. Demultiplexing is the process of taking information from one input and transmitting the same over one of several outputs.

A demultiplexer is a combinational logic circuit that receives information on a single input and transmits the same information over one of several (2^n) output lines.

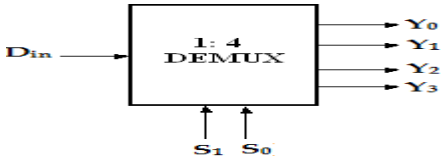


Block diagram of demultiplexer

The block diagram of a demultiplexer which is opposite to a multiplexer in its operation is shown above. The circuit has one input signal, 'n' select signals and 2^n output signals. The select inputs determine to which output the data input will be connected. As the serial data is changed to parallel data, i.e., the input caused to appear on one of the n output lines, the demultiplexer is also called a "***data distributer***" or a "***serial-to-parallel converter***".

1-to-4 line Demultiplexer

A 1-to-4 demultiplexer has a single input, D_{in}, four outputs (Y_0 to Y_3) and twoselect inputs (S_1 and S_0)



The input variable D_{in} has a path to all four outputs, but the input information is

directed to only one of the output lines. The truth table of the 1-to-4 demultiplexer is shown below

Enable	S_1	S_0	D_{in}	Y_0	Y_1	Y_2	Y_3
0	x	x	x	0	0	0	0
1	0	0	0	0	0	0	0
1	0	0	1	1	0	0	0
1	0	1	0	0	0	0	0
1	0	1	1	0	1	0	0
1	1	0	0	0	0	0	0
1	1	0	1	0	0	1	0
1	1	1	0	0	0	0	0
1	1	1	1	0	0	0	1

Truth table of 1-to-4 demultiplexer

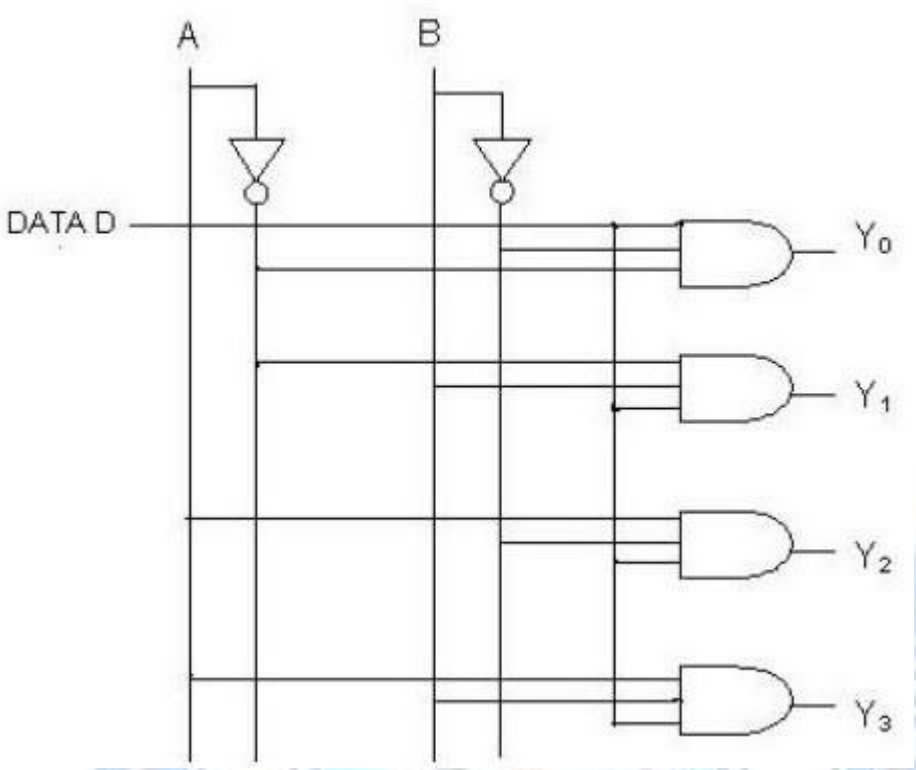
From the truth table, it is clear that the data input, D_{in} is connected to the output Y_0, when S_1= 0 and S_0= 0 and the data input is connected to output Y_1 when S_1= 0 and S_0= 1. Similarly, the data input is connected to output Y_2 and Y_3 when S_1= 1 and S_0= 0 and when S_1= 1 and S_0= 1, respectively. Also, from the truth table, the expression for outputs can be written as follows,

$$Y_0 = S_1'S_0'D_{in}$$

$$Y_1 = S_1'S_0D_{in}$$

$$Y_2 = S_1S_0'D_{in}$$

$$Y_3 = S_1S_0D_{in}$$



Logic diagram of 1-to-4 demultiplexer

Now, using the above expressions, a 1-to-4 demultiplexer can be implemented using four 3-input AND gates and two NOT gates. Here, the input data line D_{in}, is connected to all the AND gates. The two select lines S_1, S_0 enable only one gate at atime and the data that appears on the input line passes through the selected gate to the associated output line.

1-to-8 Demultiplexer

A 1-to-8 demultiplexer has a single input, **D_{in}**, eight outputs (**Y_0 to Y_7**) and three select inputs (**S_2, S_1 and S_0**). It distributes one input line to eight output linesbased on the select inputs. The truth table of 1-to-8 demultiplexer is shown below.

D_{in}	S_2	S_1	S_0	Y_7	Y_6	Y_5	Y_4	Y_3	Y_2	Y_1	Y_0
0	x	x	x	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1
1	0	0	1	0	0	0	0	0	0	1	0

1	0	1	0	0	0	0	0	0	1	0	0
1	0	1	1	0	0	0	0	1	0	0	0
1	1	0	0	0	0	0	1	0	0	0	0
1	1	0	1	0	0	1	0	0	0	0	0
1	1	1	0	0	1	0	0	0	0	0	0
1	1	1	1	1	0	0	0	0	0	0	0

Truth table of 1-to-8 demultiplexer

From the above truth table, it is clear that the data input is connected with oneof the eight outputs based on the select inputs. Now from this truth table, the expression for eight outputs can be written as follows:

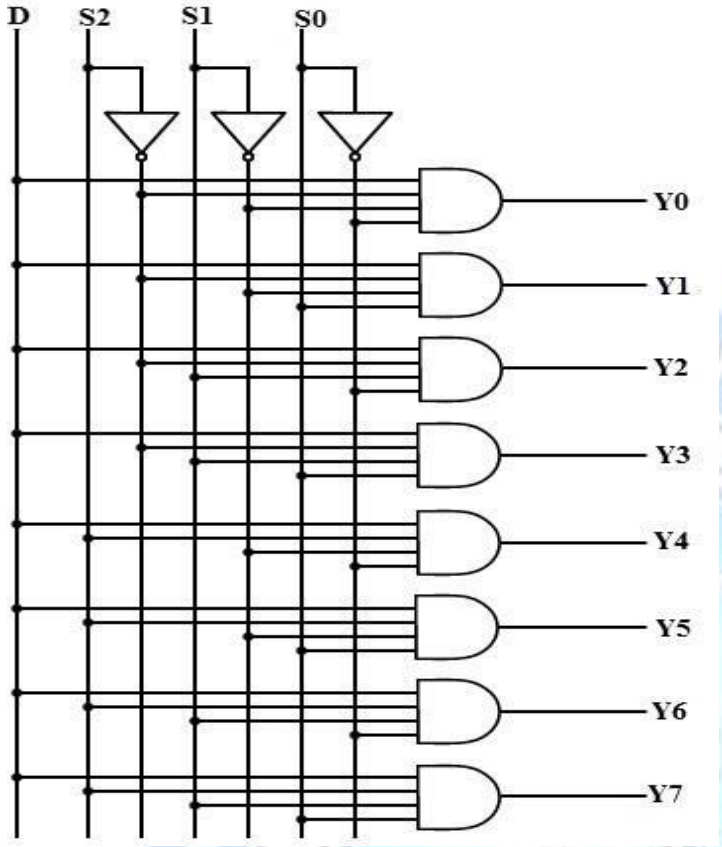
$Y_0 = S_2'S_1'S_0'D_{in}$ $\quad Y_4 = S_2S_1'S_0'D_{in}$

$Y_1 = S_2'S_1'S_0D_{in}$ $\quad Y_5 = S_2S_1'S_0D_{in}$

$Y_2 = S_2'S_1S_0'D_{in}$ $\quad Y_6 = S_2S_1S_0'D_{in}$

$Y_3 = S_2'S_1S_0D_{in}$ $\quad Y_7 = S_2S_1S_0D_{in}$

Now using the above expressions, the logic diagram of a 1-to-8 de multiplexer can be drawn as shown below. Here, the single data line, D_{in} is connected to all the eight AND gates, but only one of the eight AND gates will be enabled by the select input lines. For example, if $S_2S_1S_0 = 000$, then only AND gate-0 will be enabled and thereby the data input, D_{in} will appear at Y_0. Similarly, the different combinations of the select inputs, the input D_{in} will appear at the respective output.


D
S2
S1
S0
Y0
Y1
Y2
Y3
Y4
Y5
Y6
Y7