Unit 4

Lecture 3

Code Conversion

- The availability of a large variety of codes for the same discrete elements of information results in the use of different codes by different digital systems.
- It is sometimes necessary to use the output of one system as the input to another.
- A conversion circuit must be inserted between the two systems if each uses different codes for the same information.
- Thus, a code converter is a circuit that makes the two systems compatible even though each uses a different binary code.
- To convert from binary code A to binary code B, code converter has input lines supplying the bit combination of elements as specified by code A and the output lines of the converter generating the corresponding bit combination of code B.
- A Code converter (combinational circuit) performs this transformation by means of logic gates.
- The design procedure of code converters will be illustrated by means of a specific example of conversion from the BCD to the excess-3 code.

Design example: BCD to Excess-3 code converter

Decimal Digit	Input BCD				Output Excess-3			
	A	B	C	D	W	X	Y	Z
0	0	0	0	0	0	0	1	1
1	0	0	0	1	0	1	0	0
2	0	0	1	0	0	1	0	1
3	0	0	1	1	0	1	1	0
4	0	1	0	0	0	1	1	1
5	0	1	0	1	1	0	0	0
6	0	1	1	0	1	0	0	1
7	0	1	1	1	1	0	1	0
8	1	0	0	0	1	0	1	1
9	1	0	0	1	1	1	0	0

Table: Truth table for code converter example

Decoders and Encoders

Decoder:

- Discrete quantities of information are represented in digital systems with binary codes.
- A binary code of n bits is capable of representing up to 2^n distinct elements of the coded information.
- Decoder is a combinational circuit that converts binary information from (n) input lines to a maximum of 2^n unique output lines.

➢ If the n-bit decoded information has unused or don't-care combinations, the decoder output will have fewer than 2^n outputs.

➢n-to-m-line decoders have m <= 2^n .

3 to 8 line Decoder:

Inputs			Outputs							
x	y	z	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7
0	0	0	1	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	0	0
0	1	0	0	0	1	0	0	0	0	0
0	1	1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	1	0	0	0
1	0	1	0	0	0	0	0	1	0	0
1	1	0	0	0	0	0	0	0	1	0
1	1	1	0	0	0	0	0	0	0	1

Example: **3-to-8 line decoder**

The 3 inputs are decoded into 8 outputs, each output representing one of the minterms of the 3-input variables.

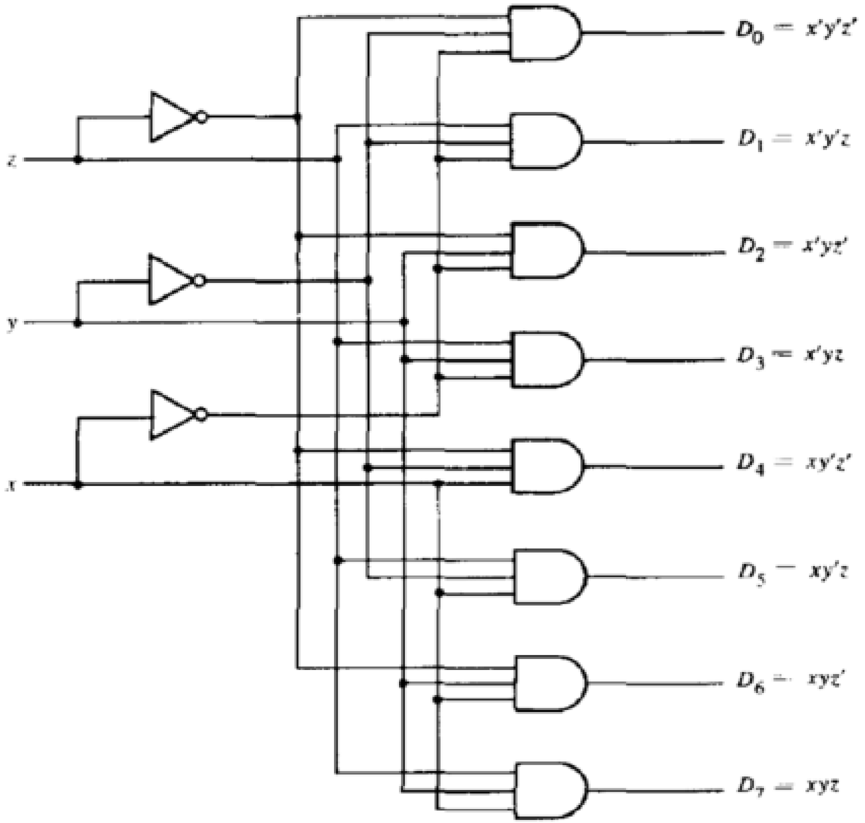


Fig: 3-to-8 line decoder

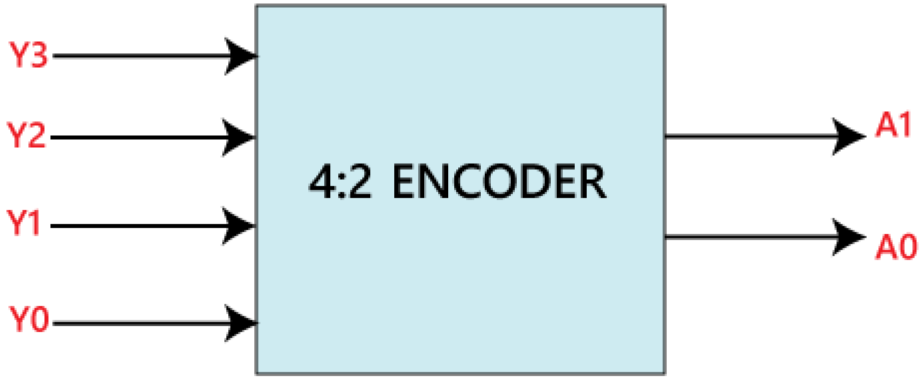
Encoder :

- It is a digital circuit that performs the inverse operation of a decoder. An encoder has 2^n input lines and n output lines.
- The output lines generate the binary code corresponding to the input value.

➢ An example of an encoder is the octal-to-binary encoder which has eight inputs, one for each of the octal digits, and three outputs that generate the corresponding binary number.

4 to 2 line Encoder:

- In 4 to 2 line encoder, there are total of four inputs, i.e., Y_0, Y_1, Y_2, and Y_3, and two outputs, i.e., A_0 and A_1.
- In 4-input lines, one input-line is set to true at a time to get the respective binary code in the output side.
- Below are the block diagram and the truth table of the 4 to 2 line encoder.



Truth table of 4 to 2 line encoder is,

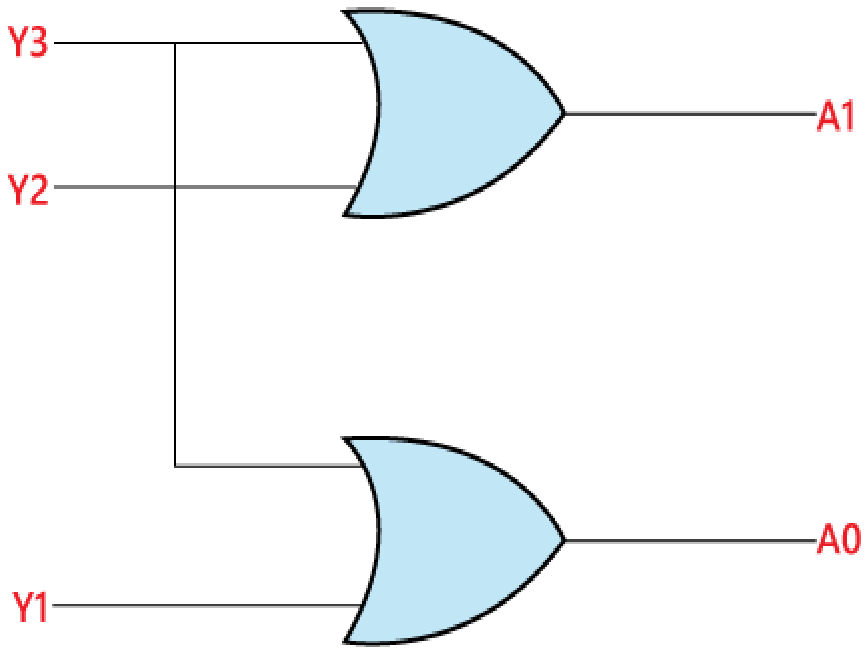
INPUT				OUTPUT	
Y3	Y2	Y1	Y0	A1	A0
0	0	0	1	0	0
0	0	1	0	0	1
0	1	0	0	1	0
1	0	0	0	1	1

From the truth table, we can find logic expressions for A0 and A1 as following,

$$A_1 = Y3 + Y2$$

$$A_0 = Y3 + Y1$$

The logical expression of the term A0 and A1 is as follows:



8 to 3 line Encoder:

- The 8 to 3 line Encoder is also known as **Octal to Binary Encoder**.
- In 8 to 3 line encoder, there is a total of eight inputs, i.e., Y_0, Y_1, Y_2, Y_3, Y_4, Y_5, Y_6, and Y_7 and three outputs, i.e., A_0, A1, and A_2.
- In 8-input lines, one input-line is set to true at a time to get the respective binary code in the output side.
- Below are the block diagram and the truth table of the 8 to 3 line encoder.

Block Diagram: