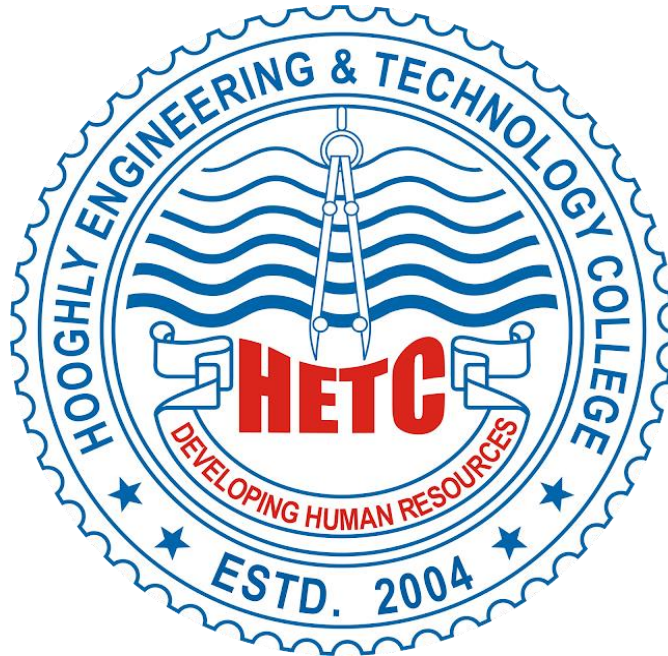


# HOOGHLY ENGINEERING AND TECHNOLOGY COLLEGE



## CONTINUOUS ASSESSMENT(CA)-2

Topic: Decoder

Name: Anand Pandey

Department: CSE

Year: 2<sup>nd</sup> Semester: 3<sup>rd</sup>

College Roll Number: 11

University Roll number: 17600123011

Subject: Analog and Digital Electronics

## **Introduction**

A decoder is a combinational circuit used to convert a code into a set of signals. It is the opposite of an encoder. A decoder circuit takes multiple inputs and gives multiple outputs. A decoder circuit takes binary data of  $n$  inputs into  $2^n$  unique output. The binary code represents the position of the desired output and is used to select the specific output that is active. In addition to input pins, the decoder also has an enable pin. The various kinds of decoder based on the input and output line present include 2:4 decoder, 3:8 decoder, 4:16 decoder, etc.

## **2:4 Decoder**

The 2 to 4 decoder has two input lines(A,B) and 4 output lines( $Y_0, Y_1, Y_2, Y_3$ ). Additionally it has an enable input. The truth table for the 2 to 4 decoder is given below:

Inputs			Outputs			
EN	A	B	$Y_3$	$Y_2$	$Y_1$	$Y_0$
0	×	×	0	0	0	0
1	0	0	0	0	0	1
1	0	1	0	0	1	0
1	1	0	0	1	0	0
1	1	1	1	0	0	0

The I.C number for the 2 to 4 decoder is 74LS139, but deriving the equation for each outputs from the truth table we can also design a 2:4 decoder using basic gates.

$$Y_0 = E \cdot \bar{A} \cdot \bar{B}$$

$$Y_1 = E \cdot \bar{A} \cdot B$$

$$Y_2 = E \cdot A \cdot \bar{B}$$

$$Y_3 = E \cdot A \cdot B$$

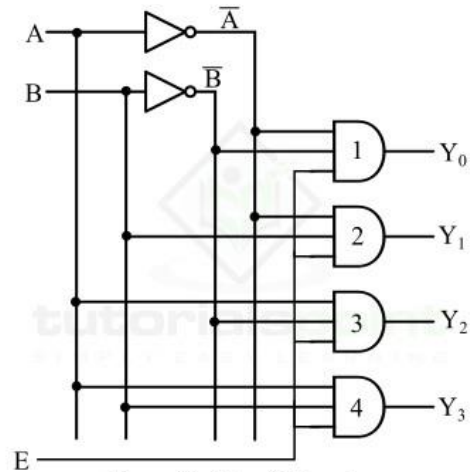


Figure 3 - 2 to 4 Decoder

### **3:8 Decoder**

The 3 to 8 decoder has three input lines and 8 output lines and one Enable input. For each combination of inputs one of the eight outputs will be active. The I.C number for a 3 to 8 decoder is 74LS138 but it can also be designed with the help of basic gates by deriving the equation for each output using its truth table.

Inputs				Outputs							
EN	A	B	C	$Y_7$	$Y_6$	$Y_5$	$Y_4$	$Y_3$	$Y_2$	$Y_1$	$Y_0$
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

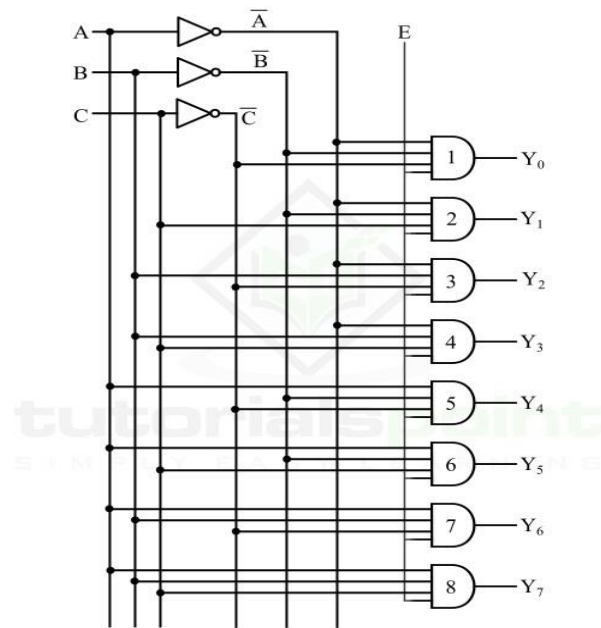


Figure 5 - 3 to 8 Decoder

### **Advantages of Decoder**

- **Increased Flexibility:** Binary decoders provide a flexible way to select one of multiple outputs based on a binary code, allowing for a wide range of applications
- **Improved Performance:** By converting a serial code into a parallel set of outputs, binary decoders can improve the performance of a digital system by reducing the amount of time required to transmit information from a single input to multiple outputs.
- **Improved Reliability:** By reducing the number of lines required to transmit information from a single input to multiple outputs, binary decoders can reduce the possibility of errors in the transformation of information.

### **Disadvantages of Decoder**

- **Increased Complexity:** Binary decoders are typically more complex circuits compared to demultiplexers, and require additional components to implement.
- **Limited to specific applications:** Binary decoders are only suitable for applications where a serial code must be converted into a parallel set of outputs.
- **Limited number of outputs:** Binary decoders are limited in their number of outputs, as the number of outputs is determined by the number of inputs and the binary code used.

## **Applications of Decoder**

- Converting digital signals into analogue signals, which are more suitable for human senses.
- Inputting data to a specified output line, as in addressing core memory.
- Code conversions
- Minimizing the effects of system decoding in high-performance memory systems.

## **Conclusion**

The 3 to 8 decoder is a combinational circuit used to convert a code of inputs into output. The decoder has  $n$  lines of input and gives  $2^n$  outputs. For each unique input code, one of the outputs is active. The decoder has many applications in analog and digital electronics like in converting digital signals to analogue signals, inputting data to a specified output line, code conversions and many more.

## **References**

- <https://www.tutorialspoint.com/digital-electronics/digital-electronics-decoders.htm>
- <https://www.electronicshub.org/binary-decoder>
- <https://www.javatpoint.com/decoder-digital-electronics>
- Fundamentals of Digital Circuits by A. Anand Kumar