Mini Project Report on

Design and Implementation of Encoder and Decoder

by

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CERTIFICATE

This is to certify that Mini Project report entitled

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is successfully completed for Second Year of Computer Engineering as prescribed by University of Mumbai.

Supervisor

(Mr. Prathmesh Gunjgur)

DECLARATION

We declare that this written submission represents our ideas and does not involve plagiarism. We have adequately cited and referenced the original sources wherever other's ideas or words have been included. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action against me by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Date: _____

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Contents

1. **Title : Design And Implementation of Encoder and Decoders**

2. **Objective :** To design and implement octal to binary encoder and binary to octal decoder using basic logic gates.

3. **Hardware & Software Requirements: Virtual Lab (Circuit Verse)**

4. **Theory :**

Encoder

A simple encoder or simply an encoder in digital electronics is a one-hot to binary converter. That is, if there are 2n input lines, and at most only one of them will ever be high, the binary code of this 'hot' line is produced on the n-bit output lines.

For example, a 4-to-2 simple encoder takes 4 input bits and produces 2 output bits. The illustrated gate level example implements the simple encoder defined by the truth table, but it must be understood that for all the non-explicitly defined input combinations (i.e., inputs containing 0, 2, 3, or 4 high bits) the outputs are treated as don't cares.

It is the reverse of a Decoder in its function.

If the input circuit can guarantee at most a single-active input, a simple encoder is a better choice than a priority encoder, since it requires less logic to implement but if not this become the major disadvantage of simple encoder that is they can generate the wrong output when there is more than one input present in a high state (logic state “1”). To rectify this problem a Priority encoder is used. They act on the request of higher priority and the rest cases go in "don't care condition".

DECODER-

In digital electronics, a binary decoder is a combinational logic circuit that converts binary information from the n coded inputs to a maximum of 2n unique outputs. They are used in a wide variety of applications, including data multiplexing and data demultiplexing, seven segment displays, and as address decoders for memory and port-mapped I/O.

There are several types of binary decoders, but in all cases a decoder is an electronic circuit with multiple input and multiple output signals, which converts every unique combination of input state to a specific combination of output states. In addition to integer data inputs, some decoders also have one or more "enable" inputs. When the enable input is negated (disabled), all decoder outputs are forced to their inactive states.

Depending on its function, a binary decoder will convert binary information from n input

signals to as many as 2n unique output signals. Some decoders have less than 2n output lines; in such cases, at least one output pattern may be repeated for different input values. A binary decoder is usually implemented as either a stand-alone integrated circuit (IC) or as part of a more complex IC. In the latter case the decoder may be synthesized by means of a hardware description language such as VHDL or Verilog. Widely used decoders are often available in the form of standardized ICs.

5. **Design :**

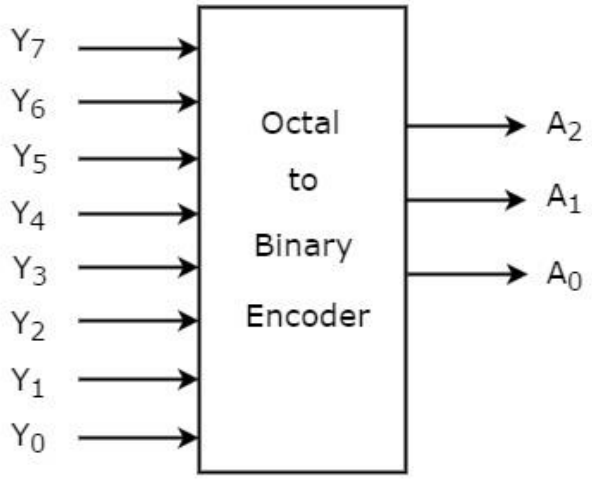

Figure 1:- Block Daigram of octal to binary encoder

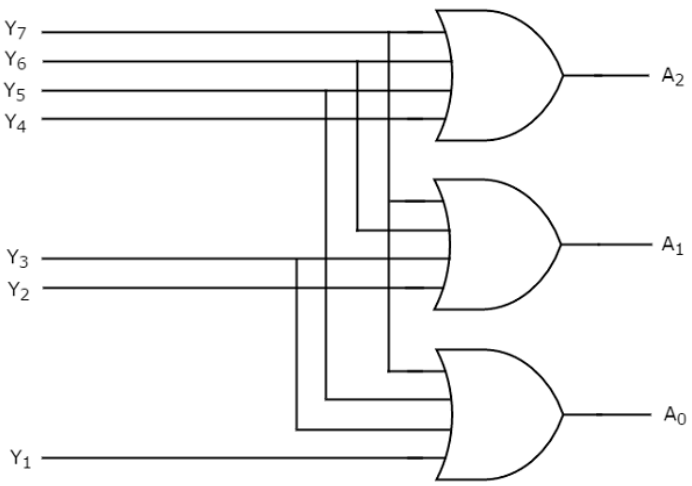

Figure 2:- Ciruit Daigram of Octal to Binary Encoder

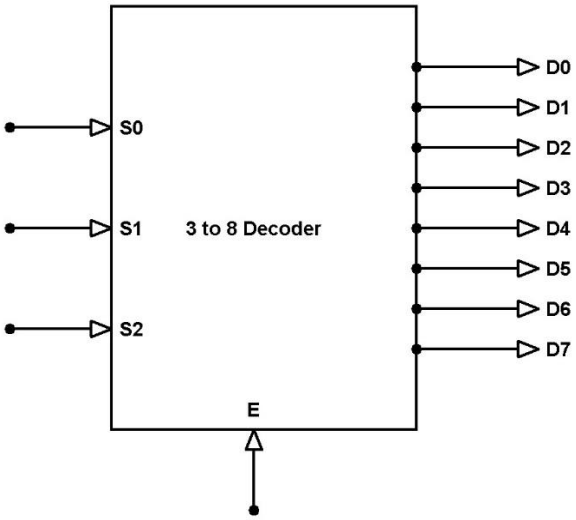

Figure 3:- Block Daigram of binary to octal decoder

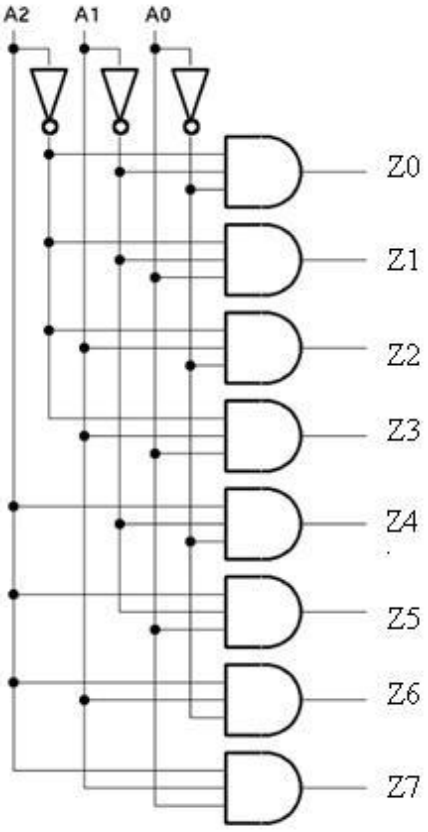

Figure 4:- Block Daigram of binary to octal decoder

6. Implementation :

Truth Table for Octal to Binary encoder

No	Inputs								Outputs		
	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	1	0	0	0	1
2	0	0	0	0	0	1	0	0	0	1	0
3	0	0	0	0	1	0	0	0	0	1	1
4	0	0	0	1	0	0	0	0	1	0	0
5	0	0	1	0	0	0	0	0	1	0	1
6	0	1	0	0	0	0	0	0	1	1	0
7	1	0	0	0	0	0	0	0	1	1	1

From Truth table, we can write the Boolean functions for each output as

x=D7+D6+D5+D4

y=D7+D6+D3+D2

z=D7+D5+D3+D1

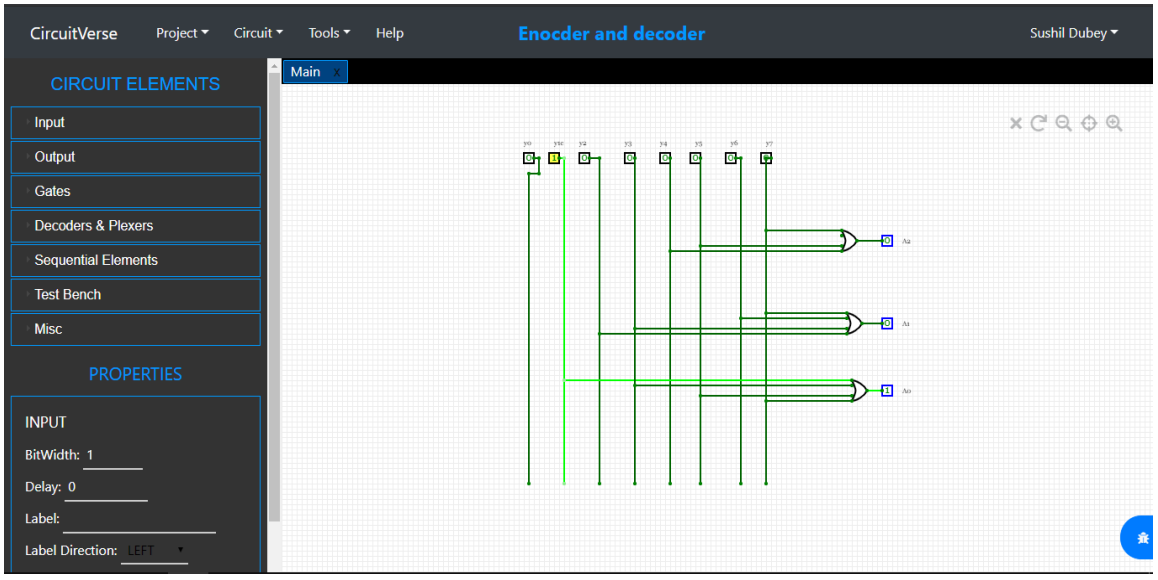

Figure 5: - Working Demonstration of Encoder

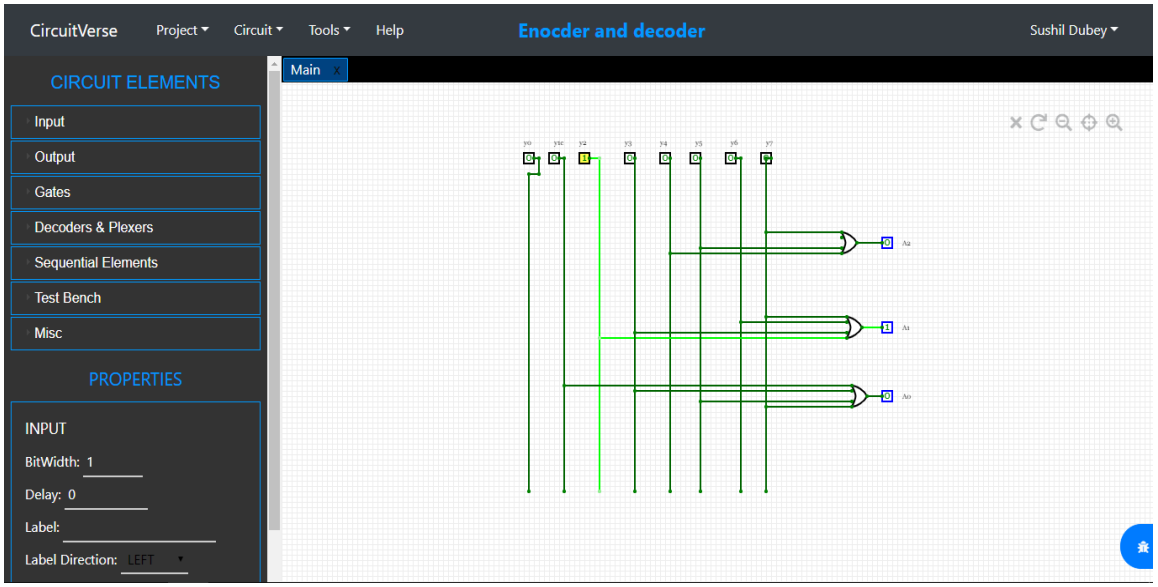

Figure 6: - Working Demonstration of Encoder

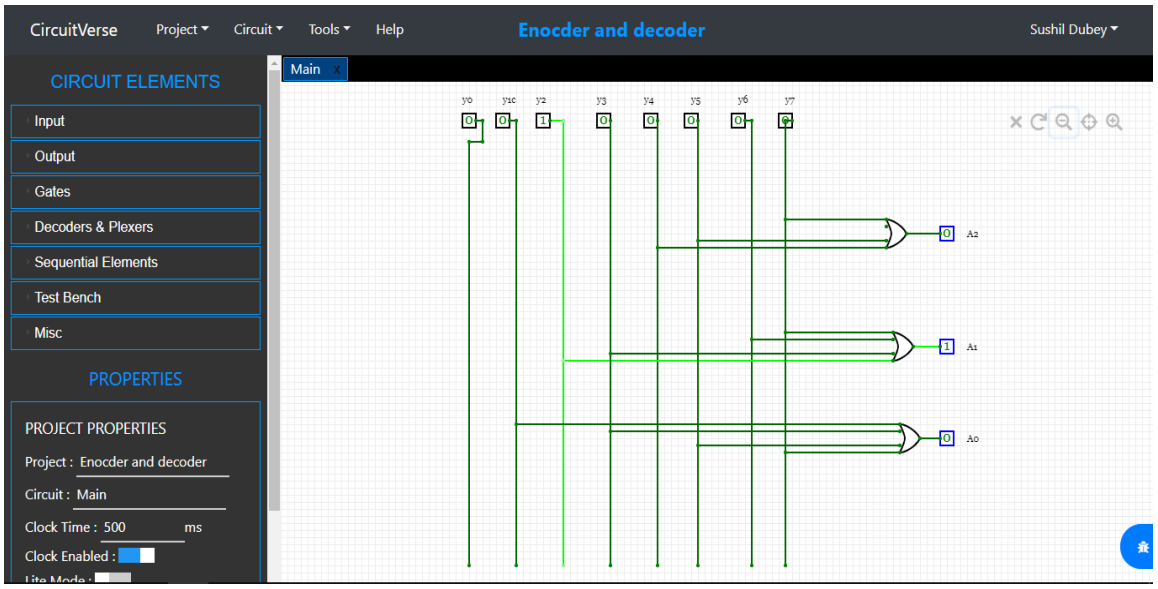

Figure 7: - Working Demonstration of Encoder

Truth Table for Octal to Binary Decoder

Inputs								Outputs		
D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	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

From Truth table, we can write the Boolean functions for each output as

Do=A’B’C’ D1=A’B’C

D2=A’BC’ D3=A’BC

D4=AB’C’ D5=AB’C

D6=ABC D7=ABC

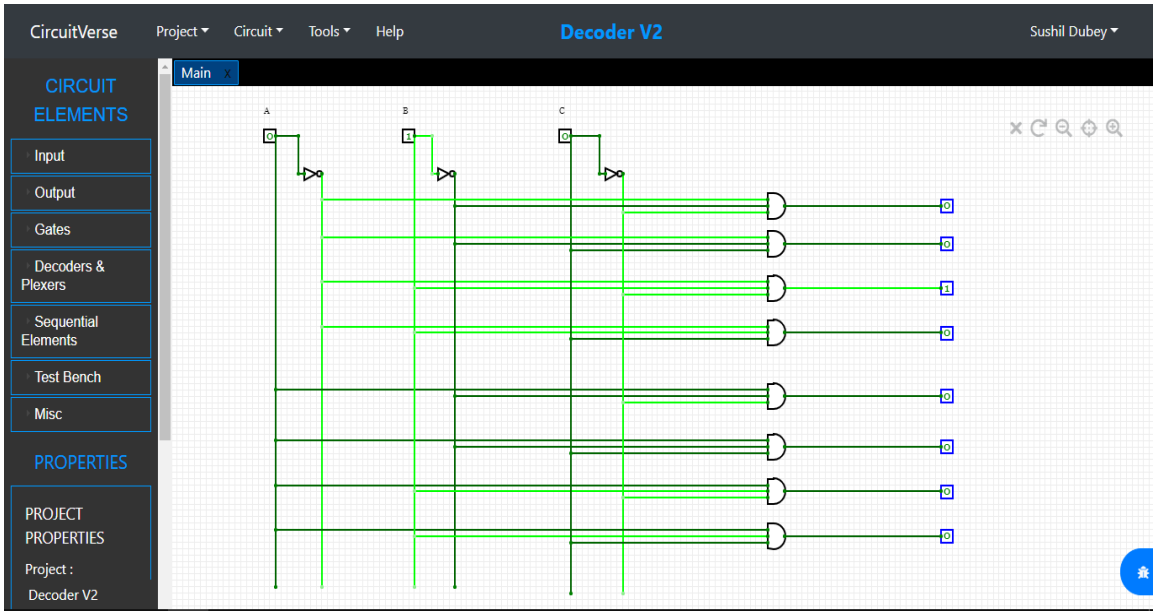

Figure 8: - Working Demonstration of Decoder

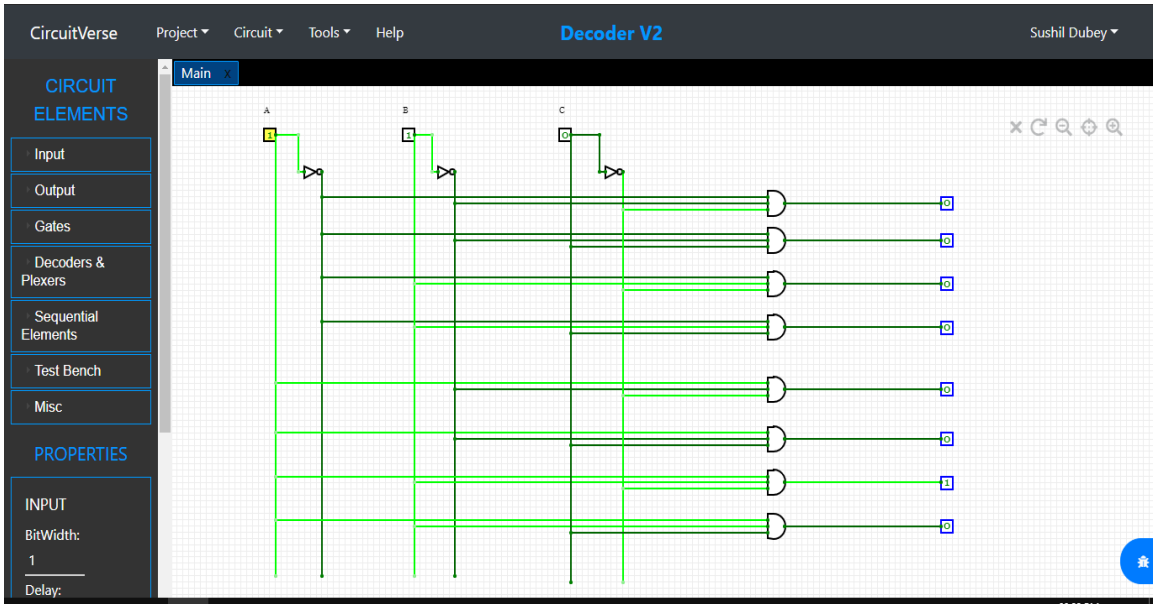

Figure 9: - Working Demonstration of Decoder

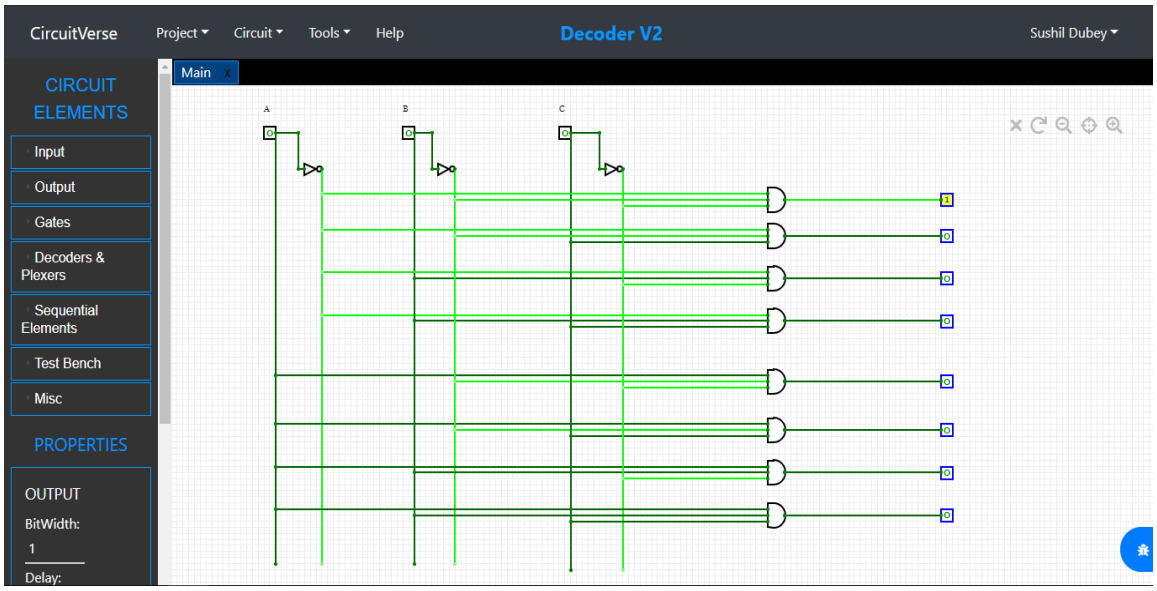

Figure 10: - Working Desmonstration of Decoder

7. Result Analysis :

An octal to binary encoder consists of eight input lines and three output lines. Each input line corresponds to each octal digit and three outputs generate corresponding binary code. In encoders, it is to be assumed that only one input is active or has a value 1 at any given time otherwise the circuit has no meaning.

As D0 does not exist in any of the expressions it is considered as Don't care condition. We can implement encoder using combination of OR gates. There is an ambiguity in the octal to binary encoder that when all the inputs are zero, an output with all 0's is generated. Also, when Y1 is 0 the output generated is all zero. This is a major problem in Octal to Binary Encoder. This can be resolved by specifying the condition that none of the inputs are active with an additional output. Encoders can be used to generate a coded output from a single active numeric input line.

3-to-8-line decoder is designed by using three NAND gates and three NOT gates. NOT gates generate the complement of input while the NAND gates generate max terms of each output.

Only one of eight outputs is high at a given time for a particular input combination, that why this decoder is also called as 1-of-8 decoder. Suppose, when ABC = 011, then only AND gate 4 has all inputs high, thus Y3 is high.

The decoder circuit works only when the Enable pin (E) is high. S0, S1 and S2 are three different inputs and D0, D1, D2, D3. D4. D5. D6. D7 are the eight outputs.

When the Enable pin (E) is low all the output pins are low.

8. Conclusion :

By using basic logic gates, we have designed and implemented an octal to binary encoder and binary to octal decoder.

Encoders are very common electronic circuits used in all digital systems. In case of pocket calculators, these are used to translate the decimal values to the binary in order to perform the binary functions such as addition, subtraction, multiplication, etc.

Encoders and Decoders are widely used in many industries such as Packaging, Textile Industry, Mobile Industry, Digital Electronic Industry, Aerospace Industry, Printing Industry etc.

Encoders and Decoders are also used in many devices such as Motor Feedback system, Linear Measurement System, Robotic vehicle with the metal detector, Automatic health monitoring systems, RF based home automation system, Speed synchronization of multiple motors in industries, War field flying robot with a night vision flying camera etc.

9. References :

[1] https://www.geeksforgeeks.org/encoder-in-digital-logic/

[2] https://circuitverse.org/

[4] https://en.wikipedia.org/wiki/Decoder_(digital)

[3] https://en.wikipedia.org/wiki/Encoder_(digital)