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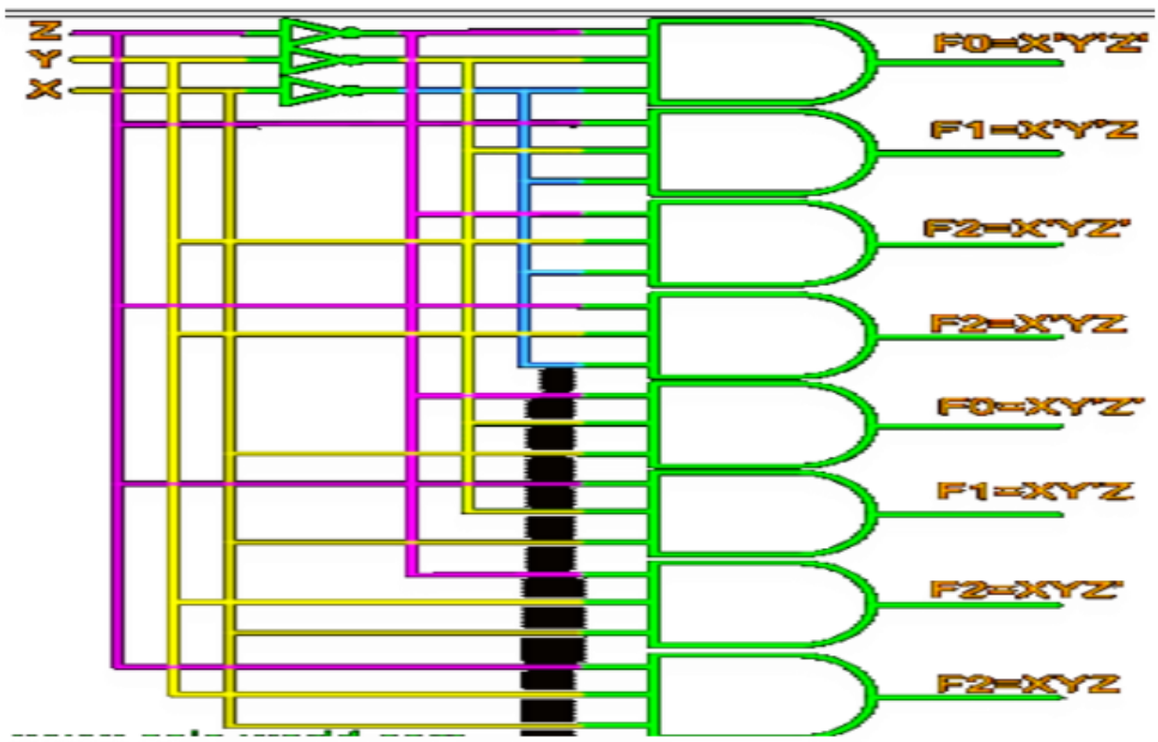
V. Evaluate my Learnings

Turn in the following requirements for the circuit of the decoder below

1. Verilog Code

2. Simulation Test bench

3. Simulation waveform corresponding to the test bench created.



Illustrate the Boolean Equation and the truth table here:

Boolean Equation:

F0 = ~X&~Y&~Z

F1 = ~X&~Y&Z

F2 = ~X&Y&~Z

F3 = ~X&Y&Z

F4 = X&~Y&~Z

F5 = X&~Y&Z

F6 = X&Y&~Z

F7 = X&Y&Z

Truth Table:

INPUTS			OUTPUTS							
X	**Y**	**Z**	**F0**	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**
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

1. Create the Verilog code here:

```
module DECODER_3TO8(F0,F1,F2,F3,F4,F5,F6,F7,X,Y,Z);
  input X,Y,Z;
  output reg F0,F1,F2,F3,F4,F5,F6,F7;

  always@(*)
  begin
    F0 = ~X&~Y&~Z;
    F1 = ~X&~Y&Z;
    F2 = ~X&Y&~Z;
    F3 = ~X&Y&Z;
    F4 = X&~Y&~Z;
    F5 = X&~Y&Z;
    F6 = X&Y&~Z;
    F7 = X&Y&Z;
  end
endmodule
```

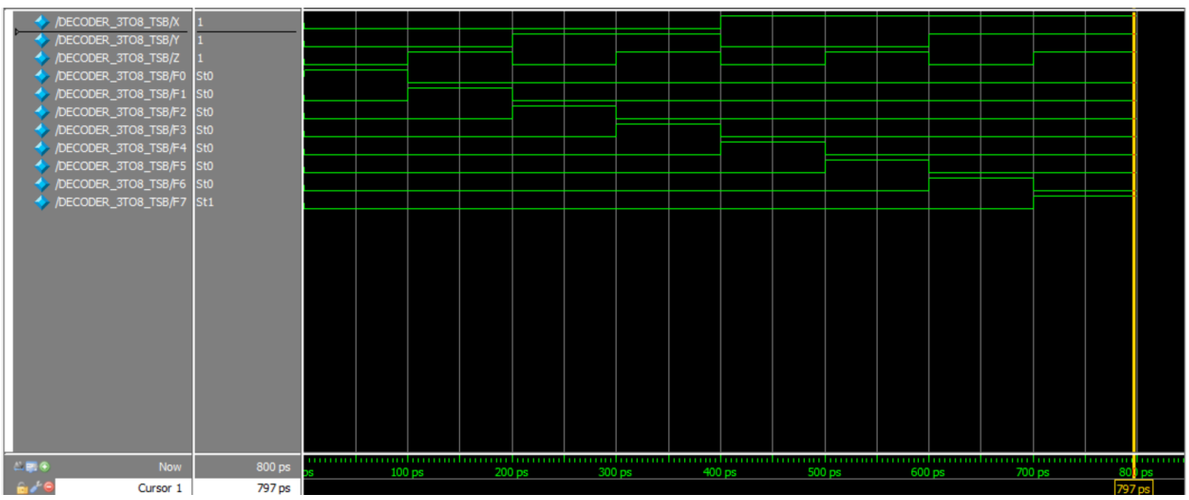
2. Create the test bench here:

```
module DECODER_3TO8_TSB ();
  reg X,Y,Z;
  wire F0,F1,F2,F3,F4,F5,F6,F7;

DECODER_3TO8 uut (
.X(X),
.Y(Y),
.Z(Z),
.F0(F0),
.F1(F1),
.F2(F2),
.F3(F3),
.F4(F4),
.F5(F5),
.F6(F6),
.F7(F7)
);
```

```
19    initial
20    begin
21      X = 0; Y = 0; Z = 0;
22      #100 X = 0; Y = 0; Z = 1;
23      #100 X = 0; Y = 1; Z = 0;
24      #100 X = 0; Y = 1; Z = 1;
25      #100 X = 1; Y = 0; Z = 0;
26      #100 X = 1; Y = 0; Z = 1;
27      #100 X = 1; Y = 1; Z = 0;
28      #100 X = 1; Y = 1; Z = 1;
29    end
30    endmodule
31
```

3. Illustrate the simulation waveform here



CONCLUSION:

1. What is a decoder and its application?

In general, a decoder is a combinational logic circuit that transforms coded inputs into coded outputs if both are distinct from one another. Decoding refers to converting encoded data from one format to another. As a result, the output code word typically has more bits than the input code. A decoder is a circuit that changes a code into a set of signals. It is called a decoder because it does the reverse of encoding. The application of the decoder is that it is a technological device that converts digital signals into analog signals. It only allows multiple input lines and generates many output lines (n-input and m-output). It converts the n-bit data inputs into the coded 2n outputs. For example, 2^3 = 8. The decoders are utilized in numerous communication initiatives that include two-device communication.

2. Explain why we need its implementation.

We need this implementation of decoders because we are using this in our everyday life, especially when we use computers for communication and other technology that uses signals. A digital decoder converts a set of digital signals into equivalent decimal code. Before the adoption of an encoder, a decoder was one of the circuits that were most frequently utilized. Once the information has been encoded by encoders, it is decoded for the user interface in the majority of output devices such as monitors, calculator displays, printers, etc.

And according to ECSTUFF4U, ONLINE ELECTRONICS, ELECTRICAL ENGINEERING KNOWLEDGE, and RESEARCH INFORMATION, there are some many applications of decoders.

Here gives some application of decoder is listed below:

- It is used in code conversion. i.e. analog to digital conversion in the analog decoder.
- It may also be used for data distribution.

- In a high-performance memory system, this decode can be used to minimize the effect of system decoding.
- The decoder is used as an address decoder in CPU memory location identification.
- It is also used in electronic circuits to convert instructions into CPU control signals.
- They are mainly used in logical circuits, and data transfer.
- They can also be used to create simple other digital logic like half adders and full adders and
- some other digital design also.
- Microprocessor selecting different I/O devices.
- It decodes to binary input to activate the LED segments so that the decimal number can be displayed.
- Microprocessor memory system selecting different banks of memory.
- The decoder can be used as a timing or sequencing signal to turn the device on or off at specific times because when the decoder inputs come from a counter that is being continually pulsed, the decoder output will be activated sequentially.
- The decoder is used whenever an output or a group of output is to be activated only on the occurrence of a specific combination of input signals.
- They can be the application of a switching function often with the fewer integrated circuit.

Reference: https://www.ecstuff4u.com/2020/03/what-are-applications-of-decoders.html