Circuit Simulation Project

8 to 3 bit Priority Encoder

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Introduction

An encoder is a kind of combinational circuit which converts multiple input signal to a coded output signal in such a way that the output signal reassembles complete information which is fed at the input of the encoder. The encoder consists of ***'2n'*** bits of input lines and ***'n'*** bits output lines. The circuit of an encoder is based on the operation of Boolean expressions.

8 to 3-bit priority encoder is an encoder that consists of 8 input lines and 3 output lines. It can also be called an Octal to a binary encoder. Each input line has a base value of 8 (octal) and each output has a base value of 2 (binary).

The truth table below gives us an idea of the operation of the 8 to 3-bit Priority Encoder.

Inputs								Outputs		
D7	D6	D5	D4	D3	D2	D1	D0	Q2	Q1	Q0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	1	X	0	0	1
0	0	0	0	0	1	X	X	0	1	0
0	0	0	0	1	X	X	X	0	1	1
0	0	0	1	X	X	X	X	1	0	0
0	0	1	X	X	X	X	X	1	0	1
0	1	X	X	X	X	X	X	1	1	0
1	X	X	X	X	X	X	X	1	1	1

Logical Expression for Output lines

- Q0 = D1 + D3 + D5 + D7

- Q1 = D2 + D3 + D6 + D7
- Q2 = D4 + D5 + D6 + D7

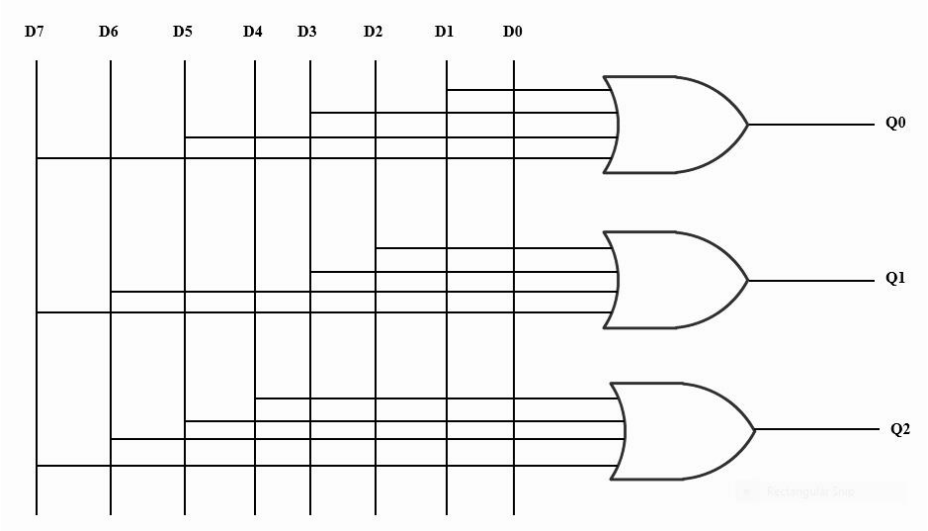


Figure 1. Basic Structural Diagram

The above Fig.1 shows the rough circuitry of the 8 to 3-bit Priority Encoder. In this project, basic circuitry of 8 to 3 priority encoder is being used, followed by DACs and ADCs for the simulation purpose. There are three 4 input OR gates which perform the OR operation, as mentioned above in the logical expressions.

Schematic Diagram

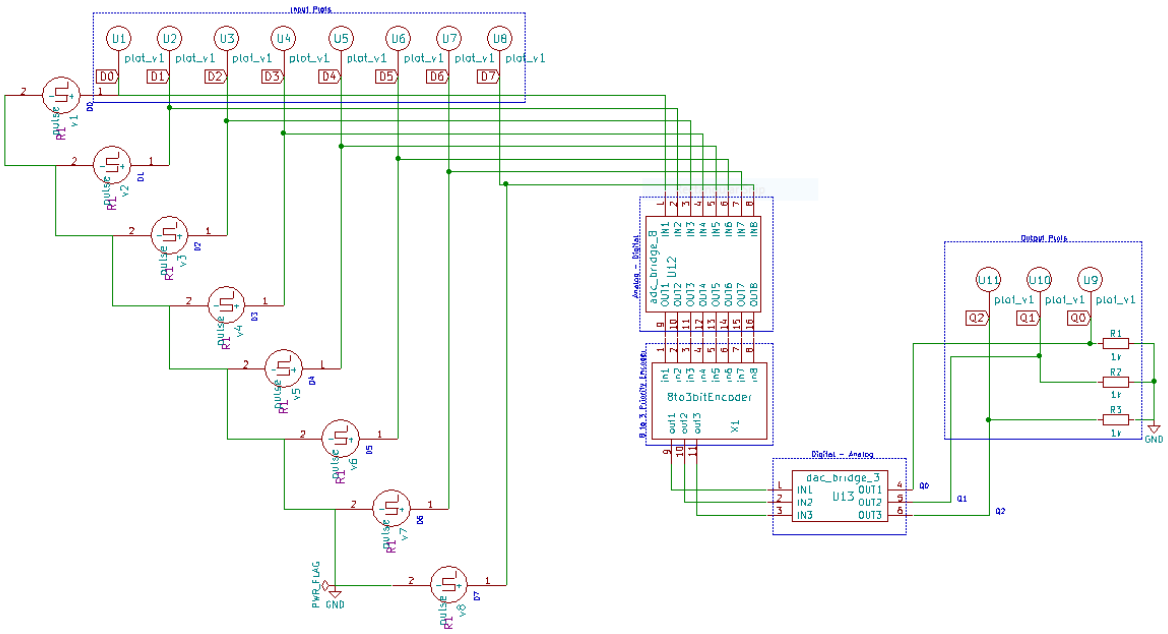


Figure 2. Final Schematic diagram

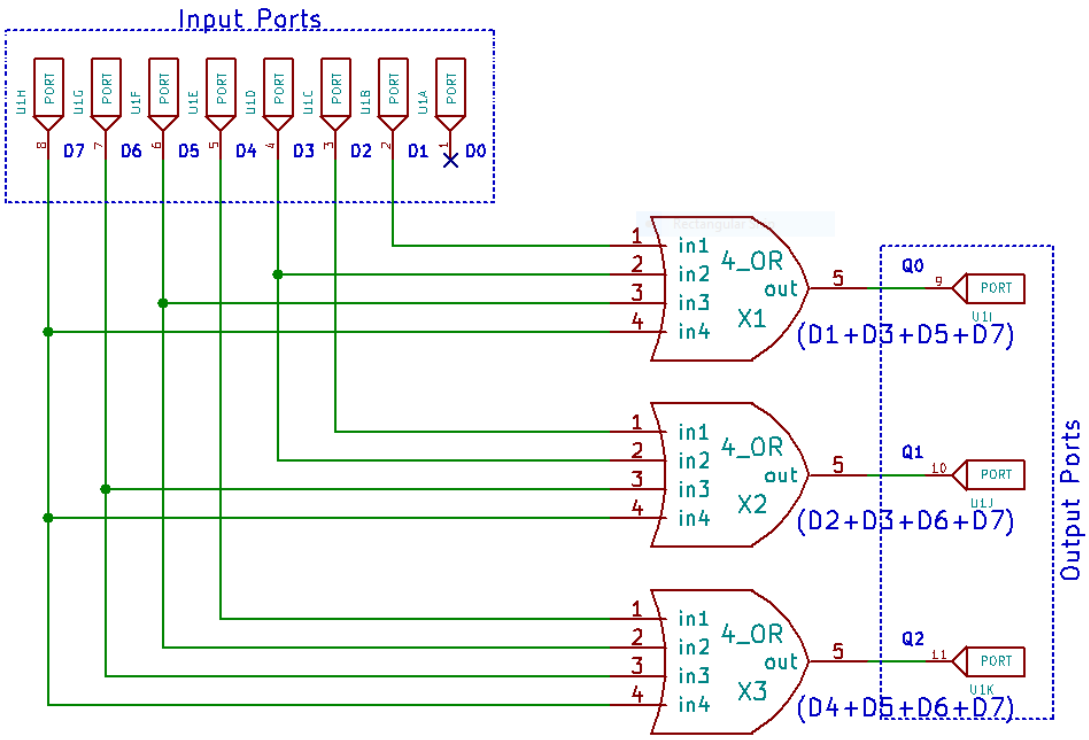


Figure 3. Sub-circuit of 8 to 3 bit encoder

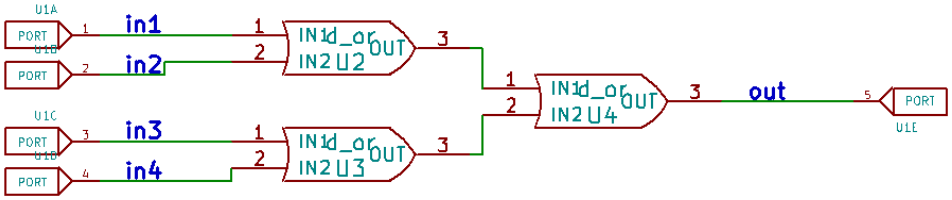


Figure 4. Sub-circuit of 4 input OR gate

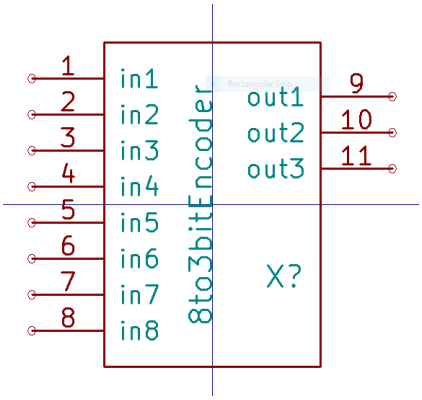


Figure 5. 8 to 3 Encoder Model

Results

Ngspice plots:

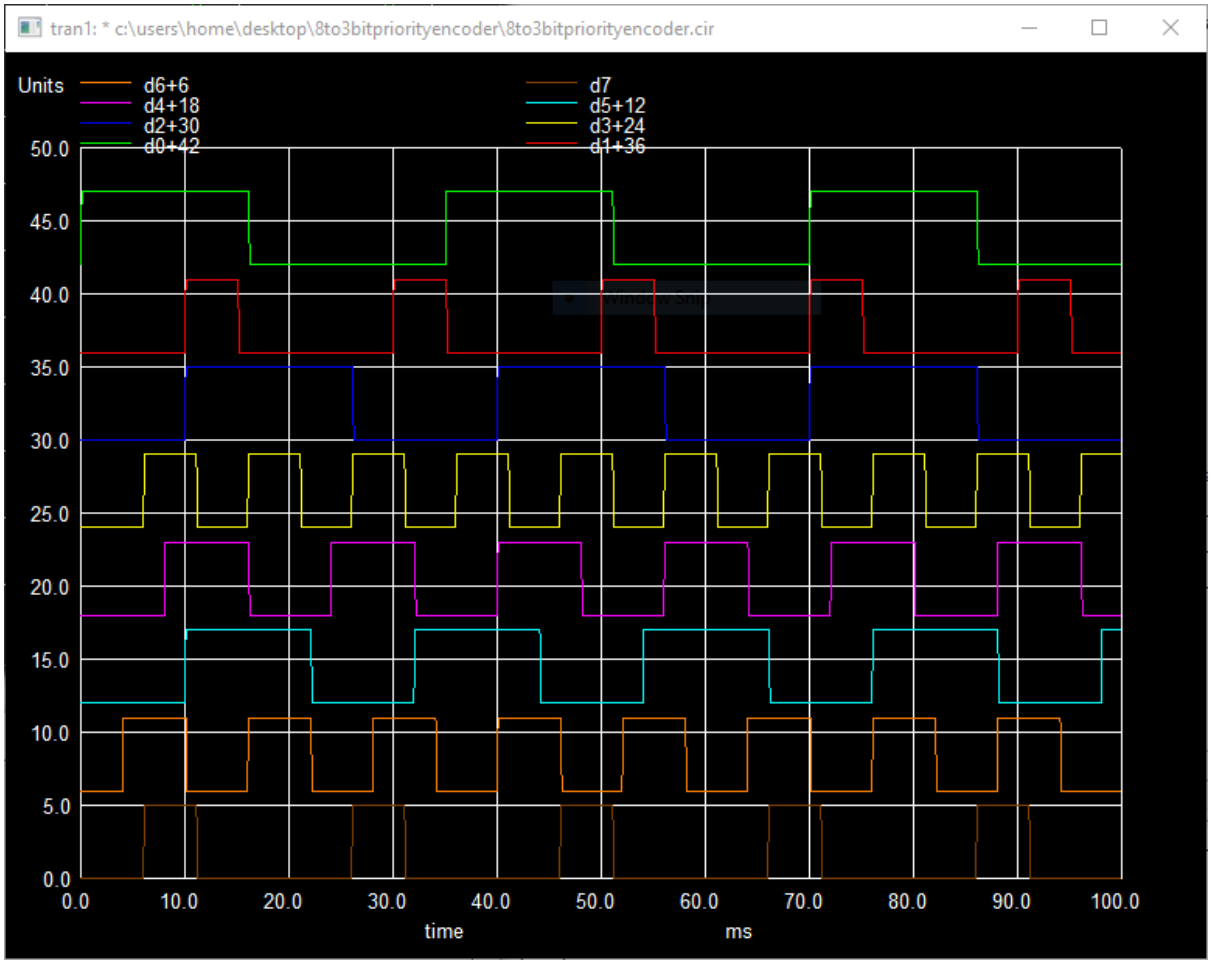


Figure 6. Ngspice waveform of all 8 input pulses

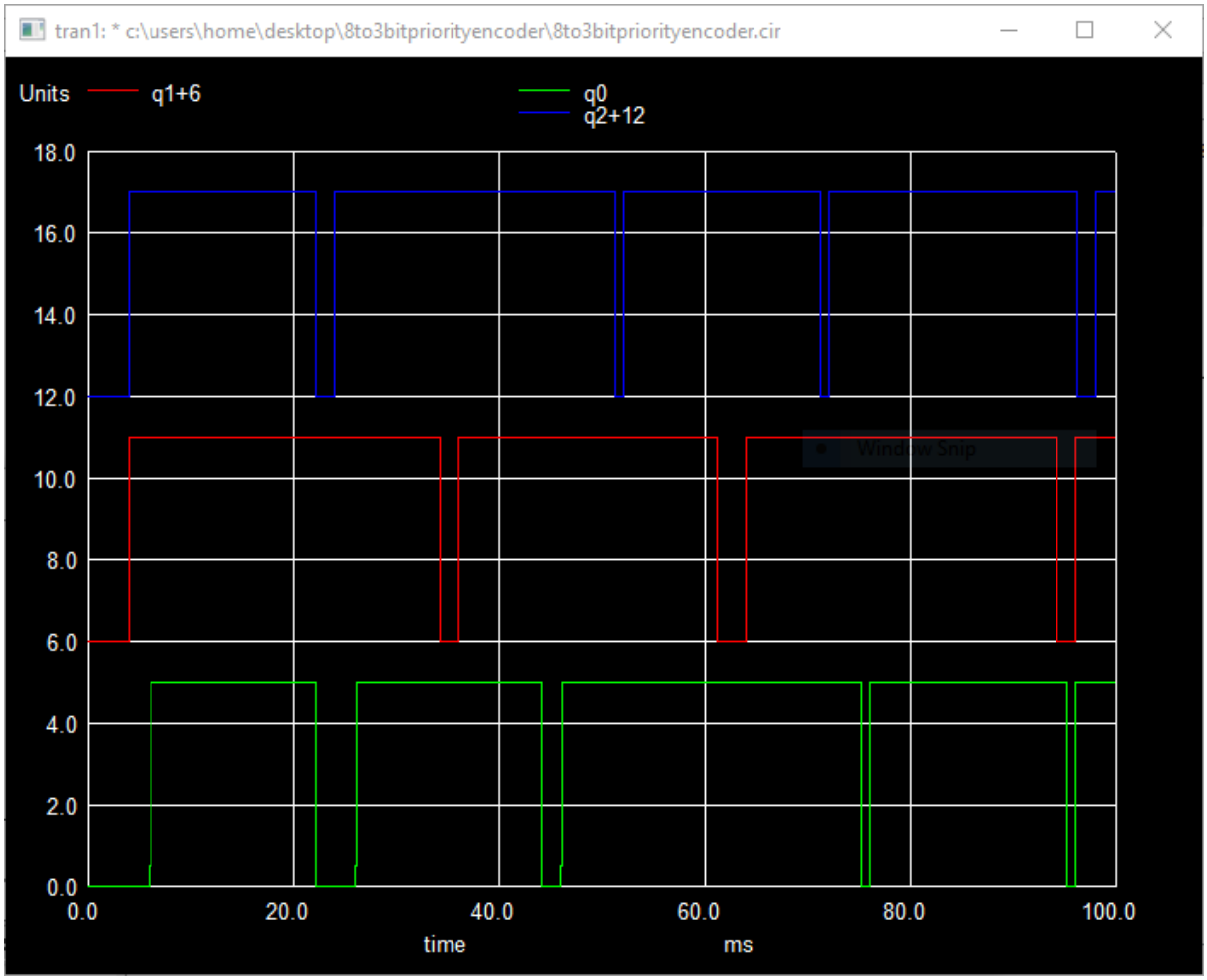


Figure 7. Ngspice waveform of all 3 outputs

Ngspice plots for individual output lines:

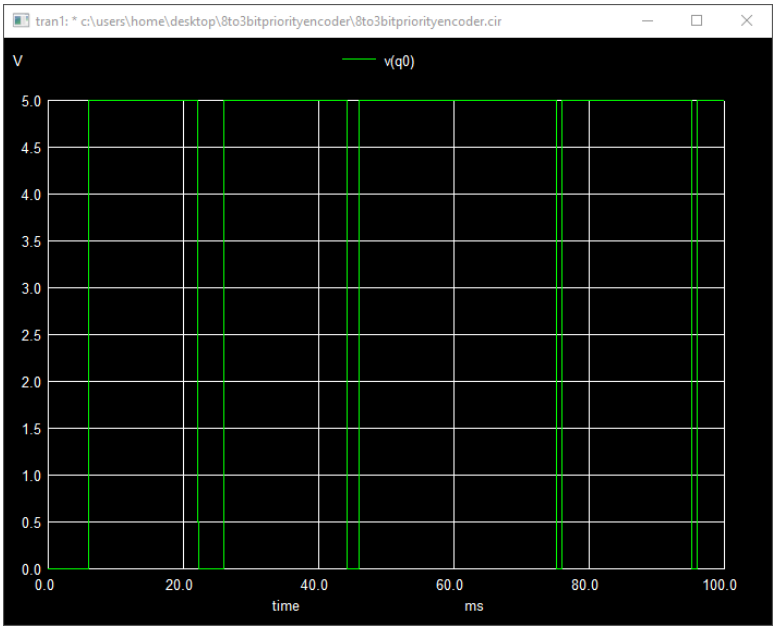


Figure 8.Output (Q0)

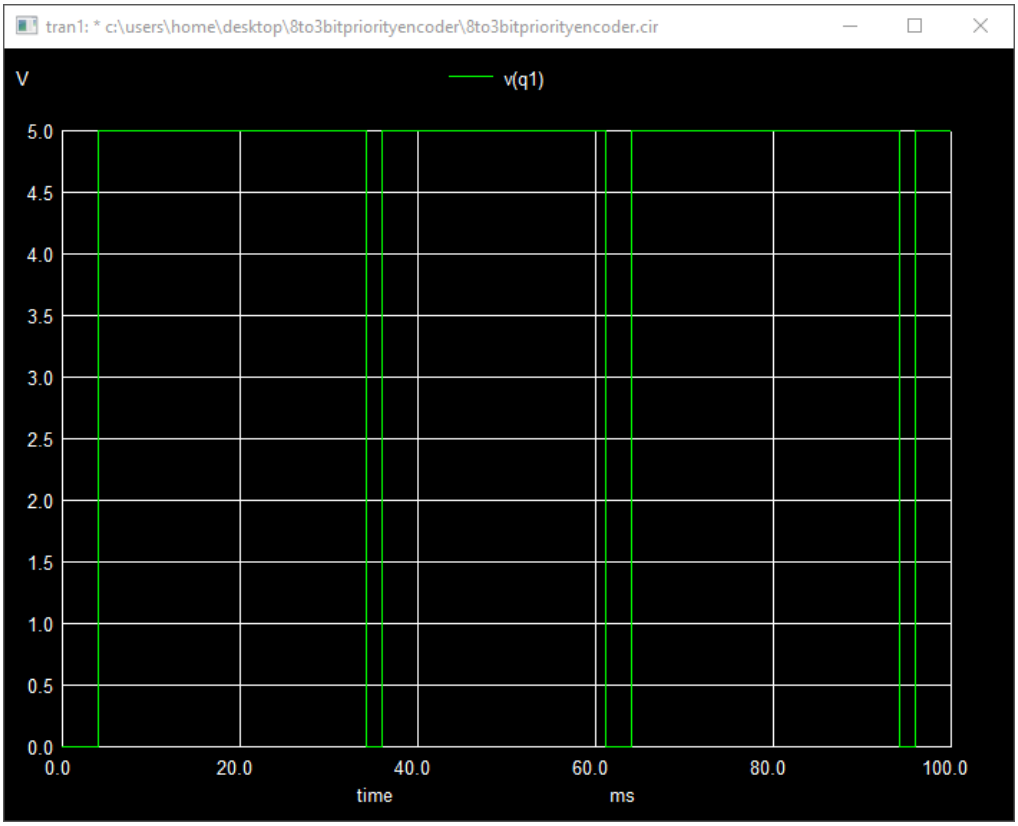


Figure 9. Output (Q1)

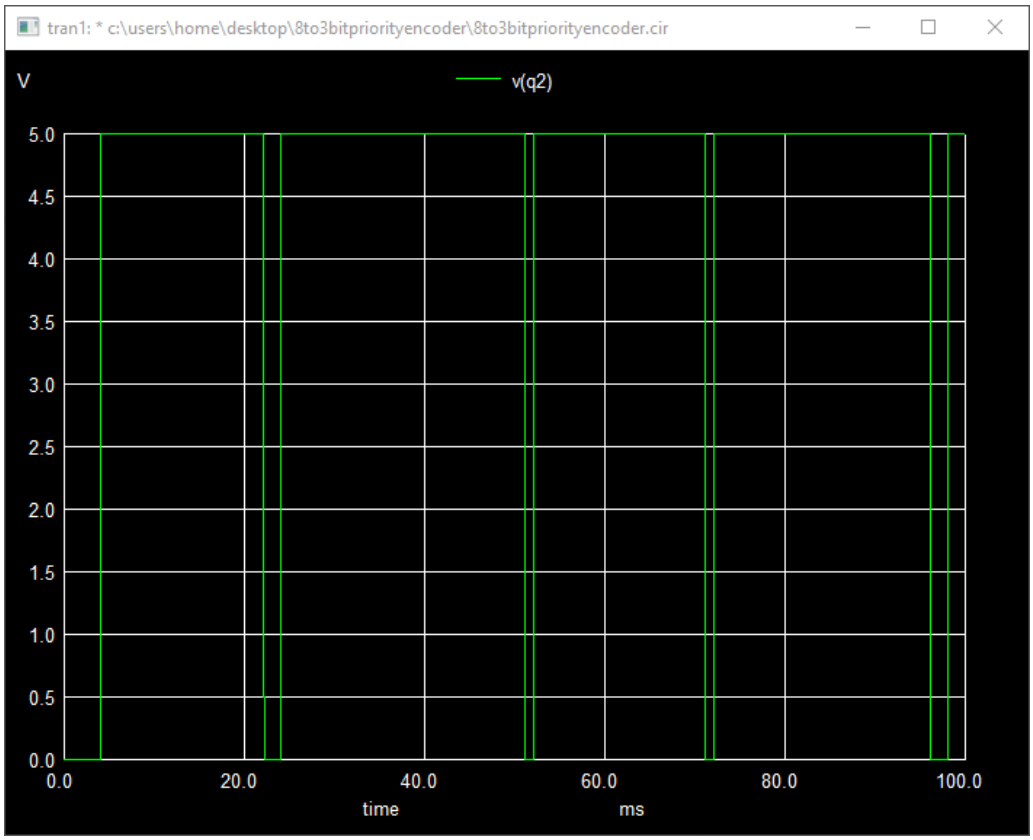


Figure 10. Output (Q2)

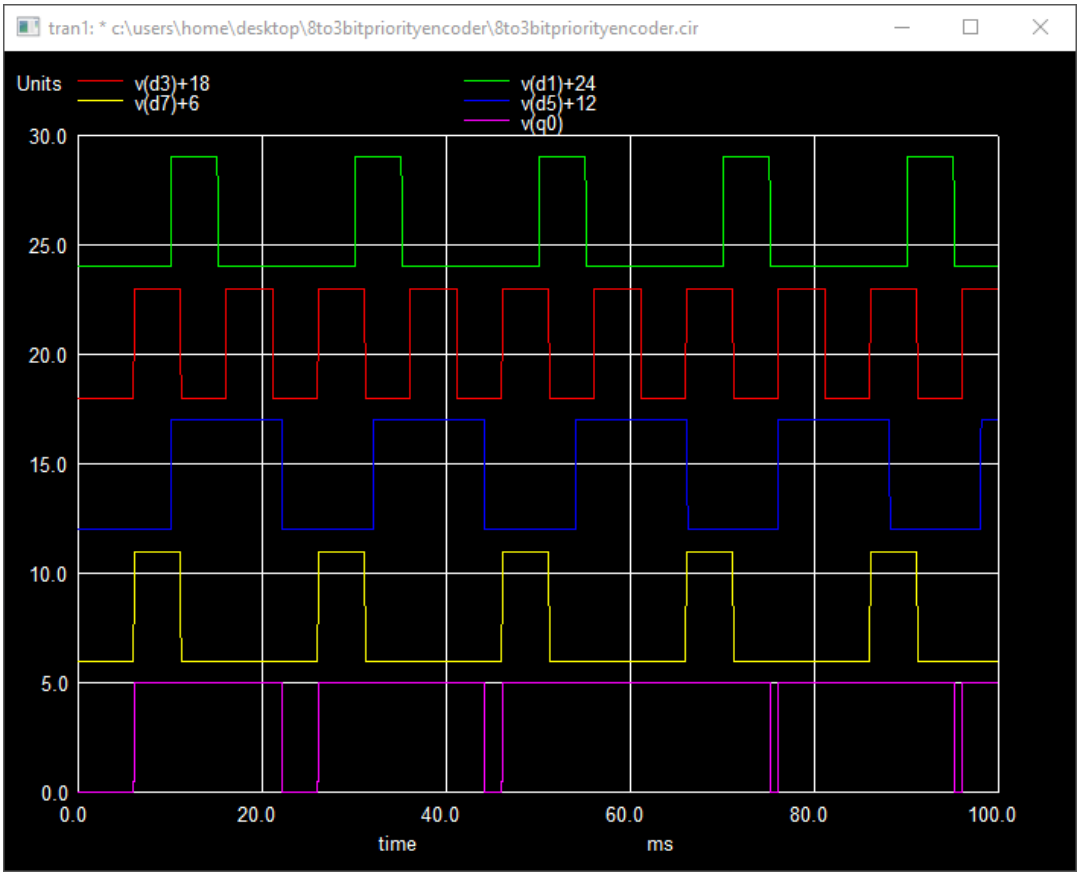


Figure 11. Q0 = D1 + D3 + D5 + D7

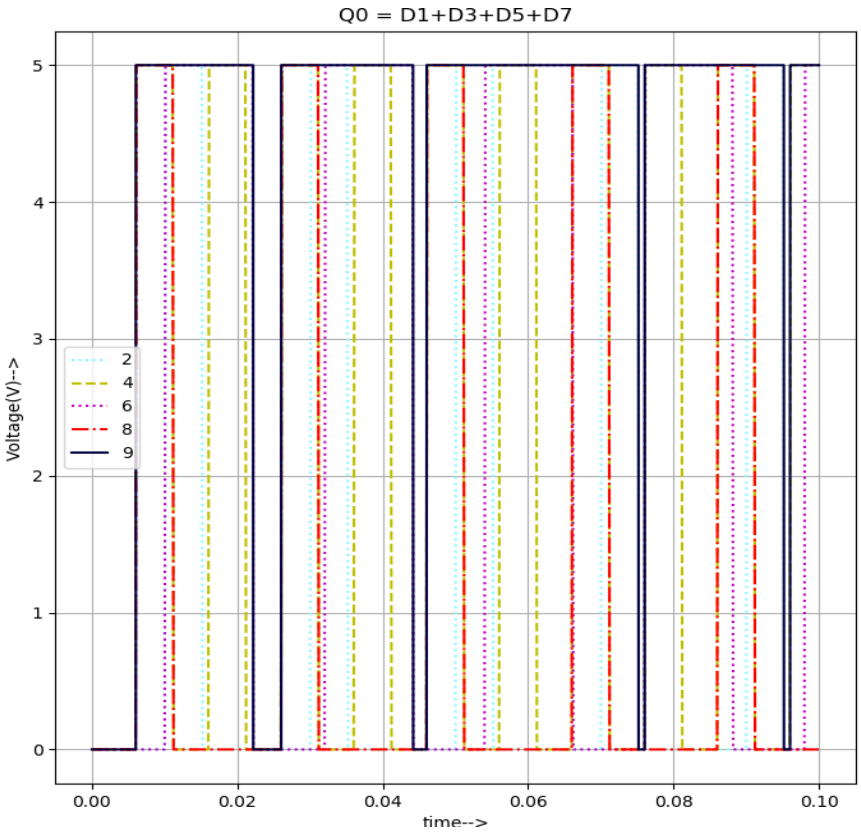


Figure 12. Python plot of Q0 (D1, D3, D5, D7)

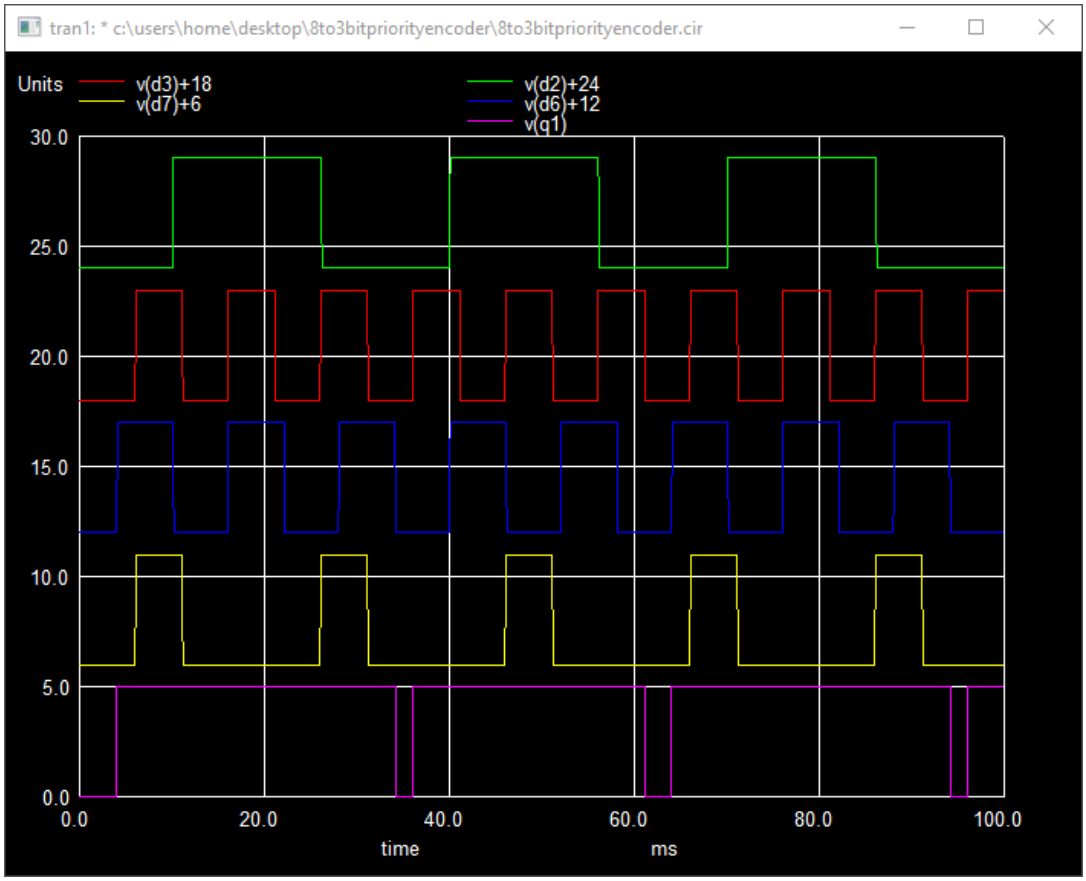


Figure 14. Q1 = D2 + D3 + D6 + D7

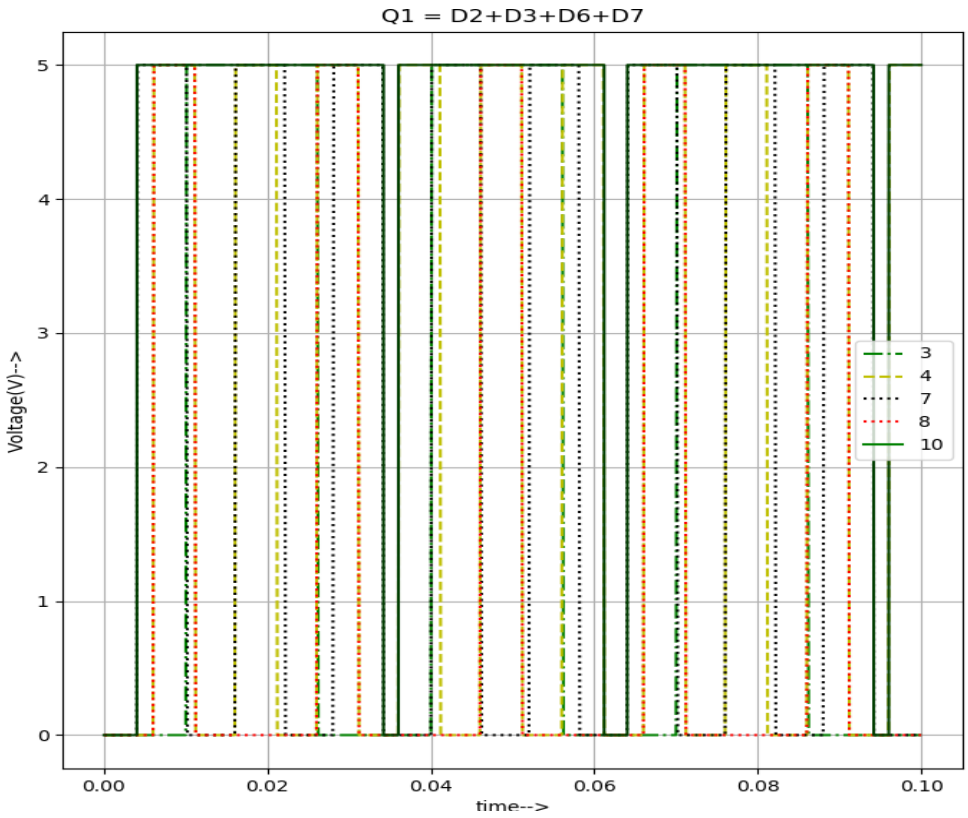


Figure 13. Python plot of Q1 (D2, D3, D6, D7)

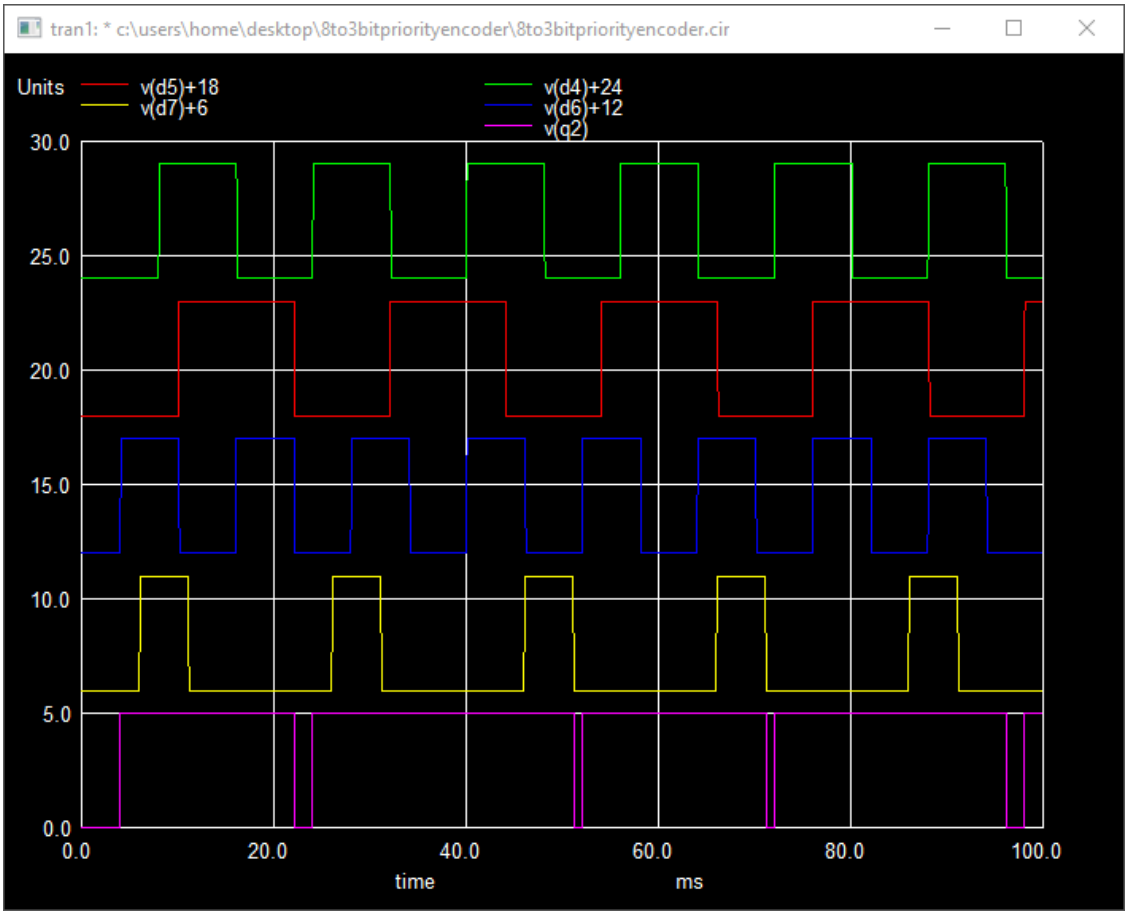


Figure 15. Q2 = D4 + D5 + D6 + D7

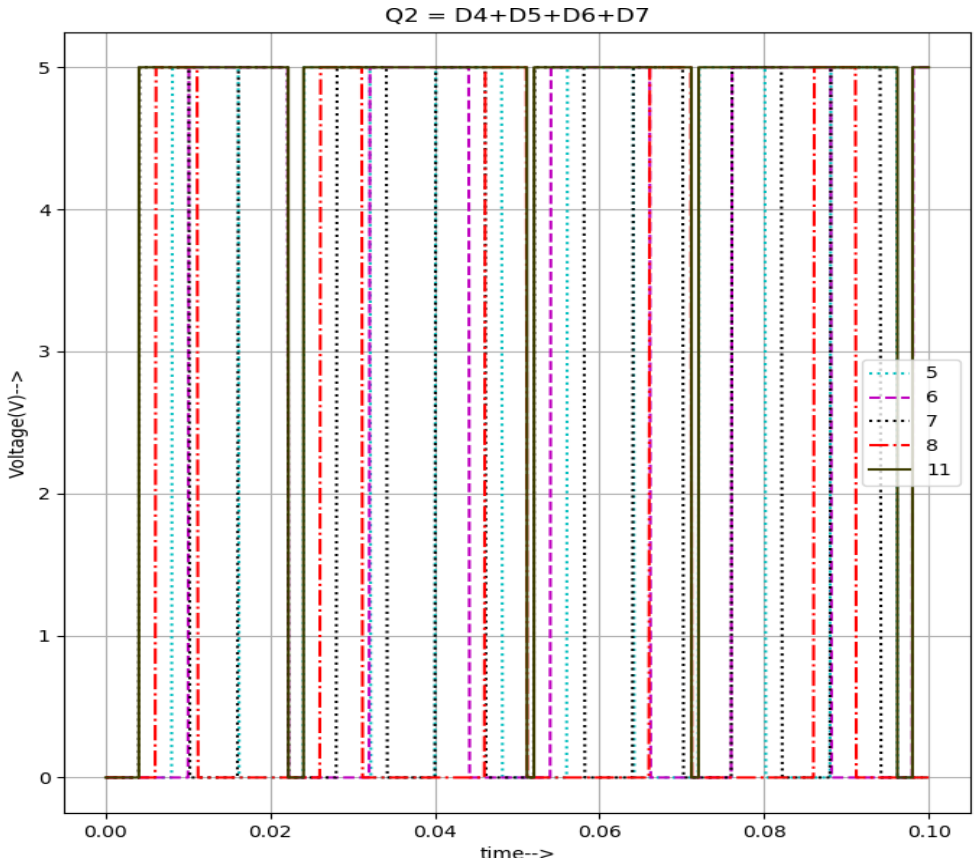
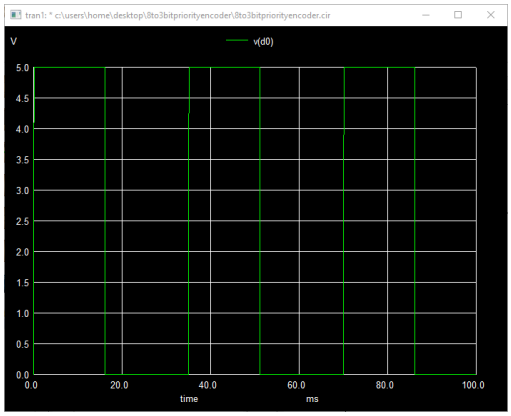
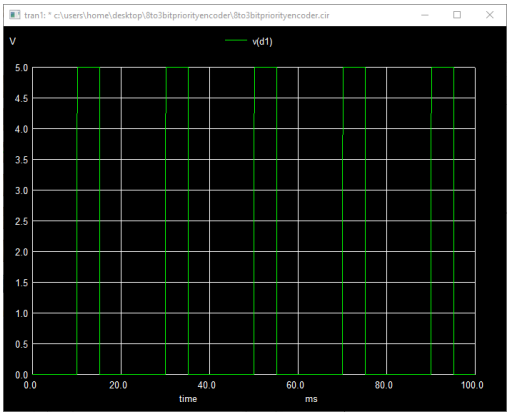
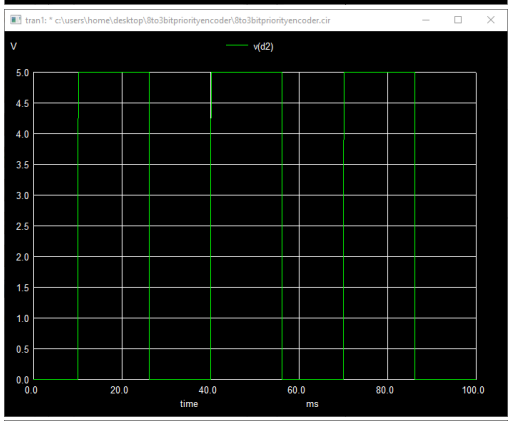


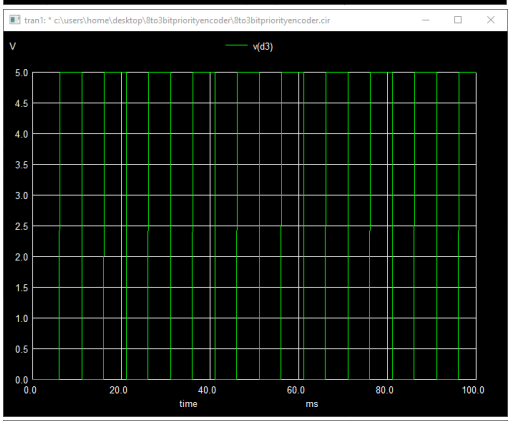
Figure 16. Python plot of Q2 (D4, D5, D6, D7)

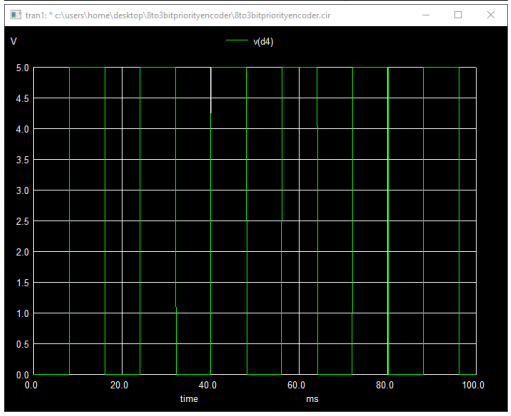
Ngspice waveforms of all Inputs:

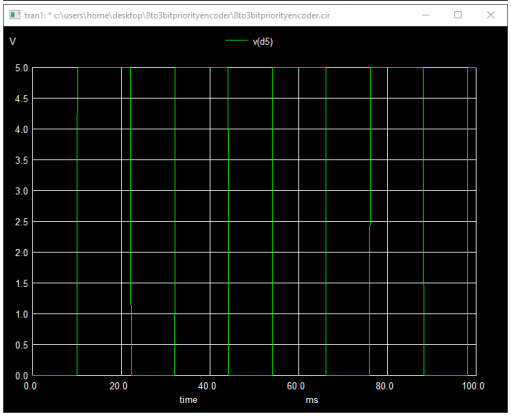


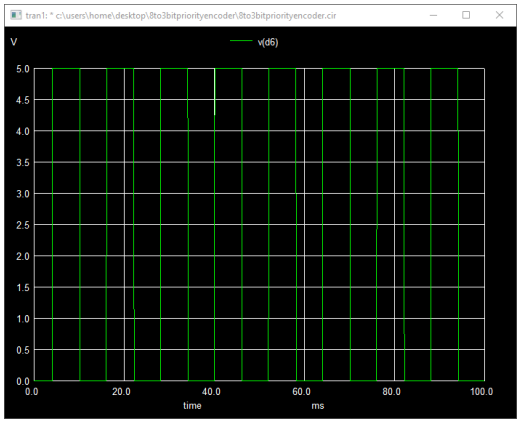


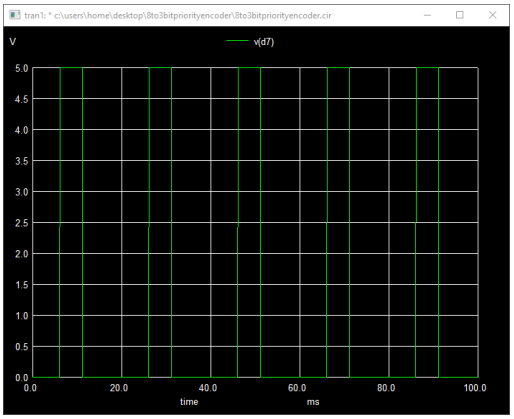




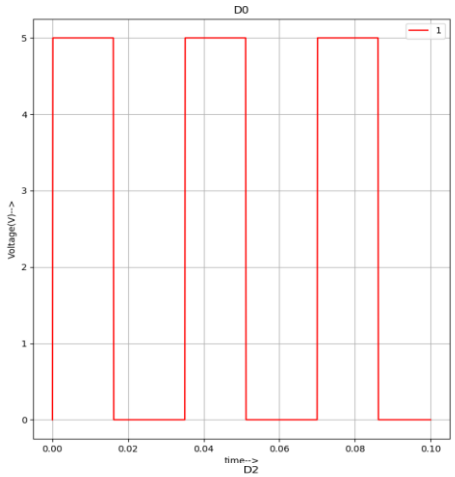


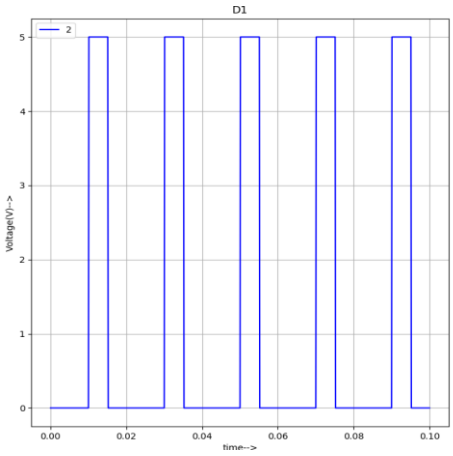


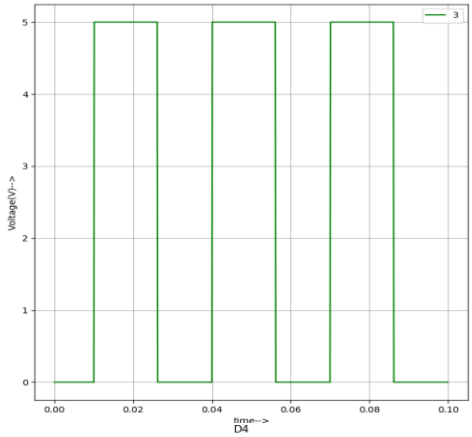


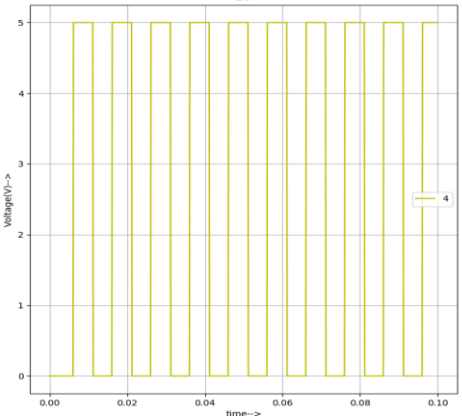


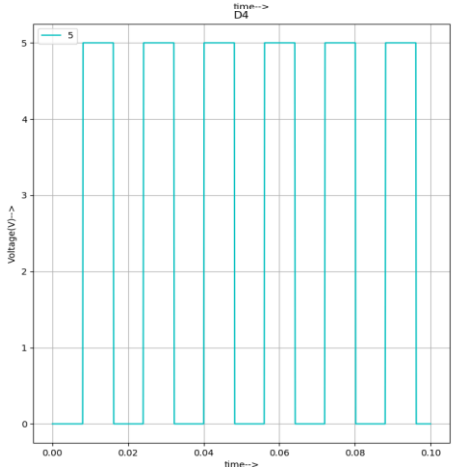
Python plots of all Inputs:

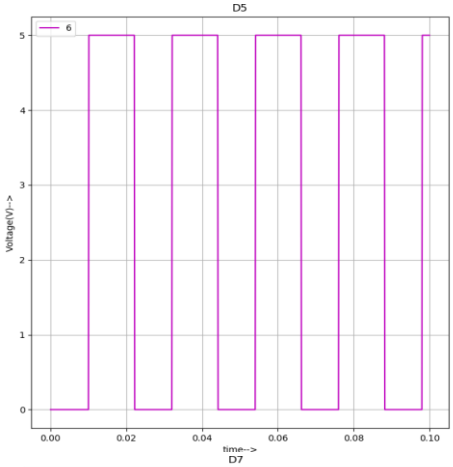


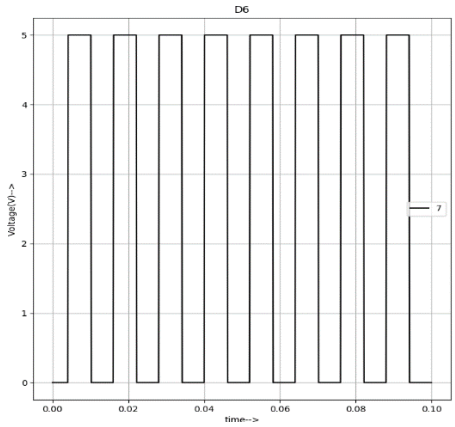


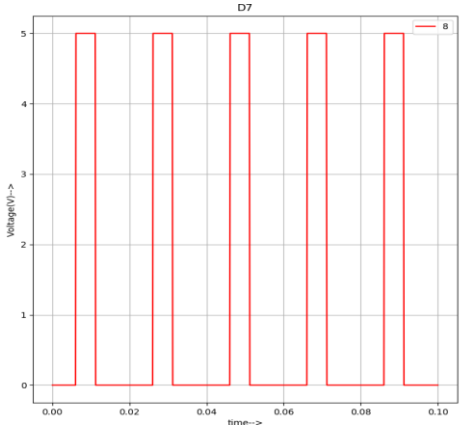












Conclusion:

Recapitulating the project, the following points can be concluded:

The circuit of 8 to 3-bit Priority Encoder was successfully simulated.

- At the output of the Encoder, we get the desired logic pulse at the output in a binary form corresponding to its octal equivalent.
- For Ex. Let say logic high pulse is applied at the input of encoder (pin 6), so we will get its binary Equivalent as,

$$(Q2, Q1, Q0) = (1\ 1\ 0)$$

References

1. Digital Fundamentals, book by Thomas L. Floyd.
2. Digital Systems: Principles and Applications, Book by Ronald J Tocci.