American International University- Bangladesh
Department of Electrical and Electronic Engineering
EEE2104: Digital Logic Design Laboratory

Title: Design of a 2 to 4 Decoder and a decimal to BCD Encoder

Introduction:

The purpose of this experiment is to construct encoder and decoder circuits. Encoder and decoder circuits are very useful in information transmission, conversion, compression and maintaining the secrecy of any information.

Theory and Methodology:

An encoder is a device or a circuit that converts information from one format or code to another. A decoder does the reverse operation of the encoder. It undoes the encoding so that the original information can be retrieved. Both the encoder and decoder are combinational circuits.

Encoding and decoding are very widely used ideas. They have applications in electronic circuits, software programs, medical devices, telecommunication and many others. In this experiment, a very basic 2-to-4 line decoder and a decimal to BCD encoder will be constructed.

A decoder can convert binary information from n input lines to a maximum of 2^n unique output lines. The 2-to-4 line decoder will take inputs from two lines and convert them to 4 lines.

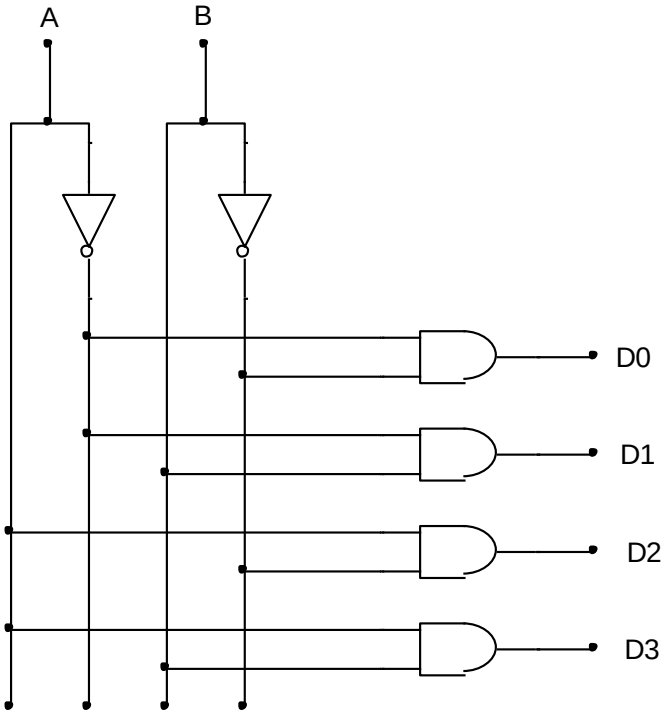

Fig.1: 2-to-4 line decoder

The expressions for implementing 2-to-4 line decoder –

D0 = A'B'

D1 = A'B
D2 = AB'
D3 = AB

Truth table for 2-to-4 line decoder is given below –

A	B	D0	D1	D2	D3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

A decimal to BCD encoder converts a decimal number into Binary Coded Decimal (BCD).

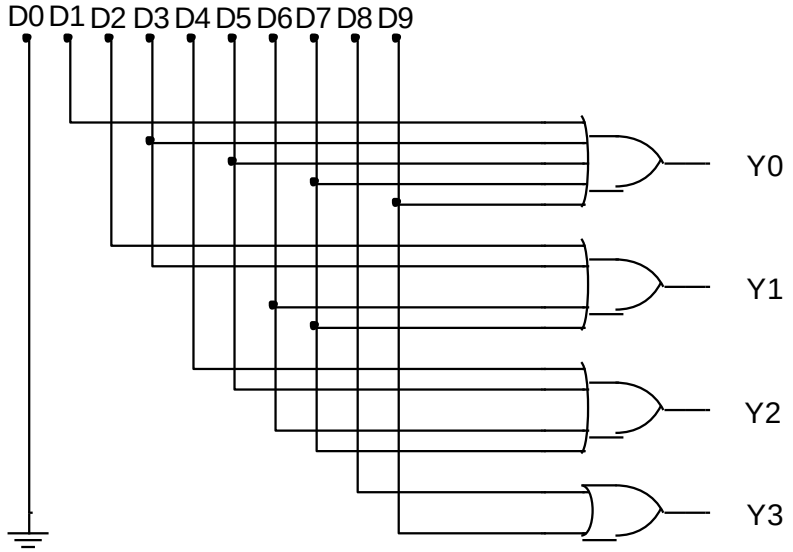

Fig.2: Decimal to BCD encoder

The expressions for implementing the decimal to BCD encoder –

Y0 = D1 + D3 + D5 + D7 + D9
Y1 = D2 + D3 + D6 + D7
Y2 = D4 + D5 + D6 + D7
Y3 = D8 + D9

Truth table for decimal to BCD encoder is given below –

Dec.	Y3	Y2	Y1	Y0
D0	0	0	0	0
D1	0	0	0	1
D2	0	0	1	0
D3	0	0	1	1
D4	0	1	0	0
D5	0	1	0	1

D6	0	1	1	0
D7	0	1	1	1
D8	1	0	0	0
D9	1	0	0	1

Priority encoder:

A priority encoder is a circuit or algorithm that compresses multiple binary inputs into a smaller number of outputs. The output of a priority encoder is the binary representation of the original number starting from zero of the most significant input bit. They are often used to control interrupt requests by acting on the highest priority request. If two or more inputs are given at the same time, the input having the highest priority will take precedence.

In this experiment a 4-to 2 priority encoder with a priority sequence of 2,1,3,0 has been shown. It means, in this priority encoder 2 has the highest priority and 0 has the lowest. If 2 is high then other numbers are ignored (even if any of them are high at the same time) and output would be binary representation of 2, i.e., Y_1Y_0=10. If 2 is found to be low, then next priority is given to 1. So, in this case if 1 is high, then 3 and 0 are ignored and output will be binary representation of 1, i.e., Y_1Y_0=01 and so on.

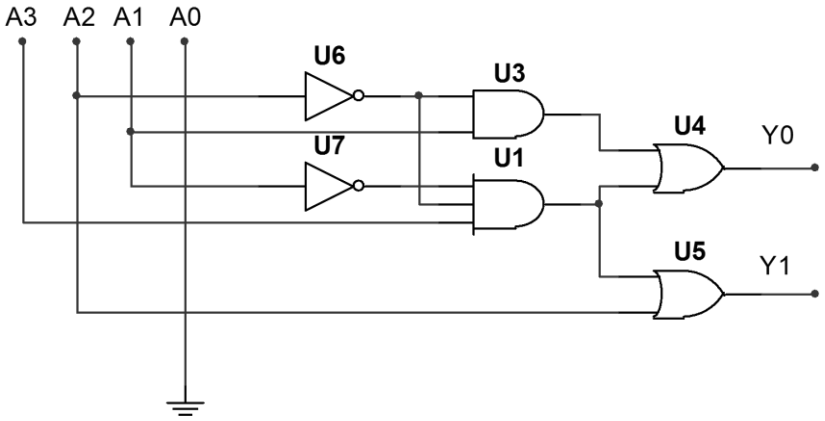

Fig .3: 4-to 2 priority encoder with a priority sequence of 2,1,3,0

The expressions for implementing the above priority encoder–

Y0 = A2'.A1 + A3.A2'.A1'
Y1 = A2 + A3.A2'.A1'

Truth table for this priority encoder is given below –

A3	A2	A1	A0	Y1	Y0
x	1	x	x	1	0
x	0	1	x	0	1
1	0	0	x	1	1
0	0	0	1	0	0

Pre-Lab Homework:

Read about the characteristics of encoder and decoder circuits from any book or websites and use PSIM to generate the output of the circuits provided in this lab sheet. Save the simulation results and bring it to the lab.

Apparatus:

1.	NOT Gate -	IC 7404	1[pcs]
2.	AND Gate -	IC 7408	1[pcs]
3.	OR Gate -	5 input OR	1[pcs]
		4 input OR	2[pcs]
		2 input OR	1[pcs]

Precautions:

1. Make sure that all the LEDs and the toggle switches of the trainer board are working properly.

2. Do not short any connections. Short connection can produce heat (due to high current flow) which is harmful for the components.

Experimental Procedure:

1. Connect the circuit according to the figures.

2. Use the toggle switches on the trainer board for providing input signal to the circuits. Connect the outputs to the LEDs on the trainer board.

3. Apply the input signals and observe and note the corresponding output signals.

Simulation and Measurement:

Compare the simulation results with your experimental data and comment on the differences (if any).

Results/ Findings:

Students will implement the circuit in the Trainer Board and match the theoretically obtained truth table by matching outputs for individual input configurations. If the practically obtained truth table does not match they will also investigate the errors.

Reference:

http://www.tutorialspoint.com/computer_logical_organization/combinational_circuits.htm