



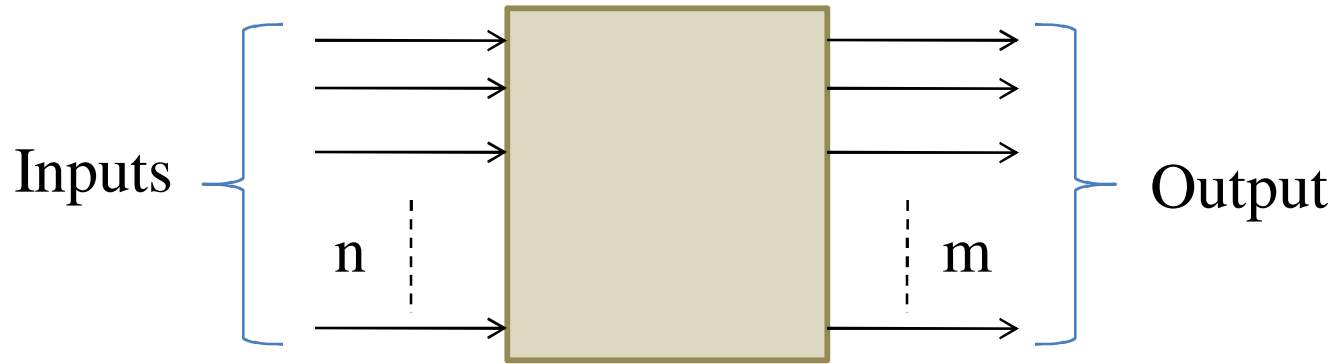
Dhirubhai Ambani Institute of Information and Communication Technology

EL114

Digital Logic Design

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DA-IICT, Gandhinagar

Combinational logic Circuit



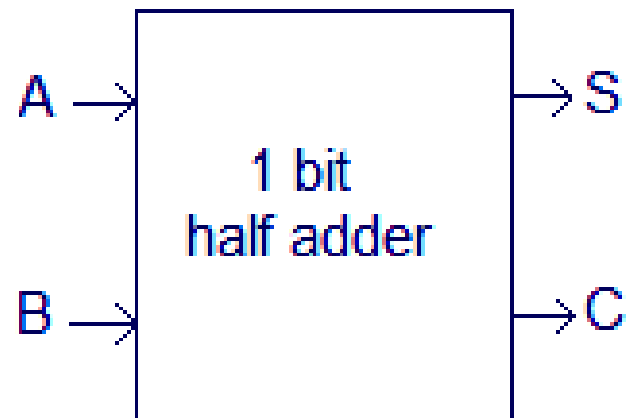
Combinational Circuit Realization for

- Given Statement and Requirement
- Given Truth Table
- Given Boolean Expression, Minterms/Maxterms

Combinational Circuit Realization for

- Various Code-converters
- Various Half Adders/Full Adders
- Various Half Subtractions/Full Subtractors

Half Adder and Full Adder



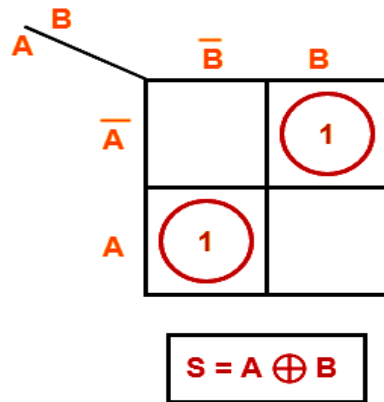
Schematic

Inputs		Outputs	
A	B	S	C
0	0	0	0
1	0	1	0
0	1	1	0
1	1	0	1

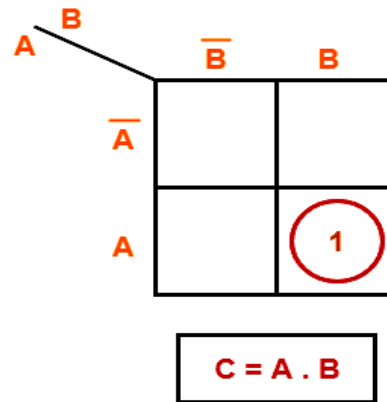
Truth table

Half Adder and Full Adder

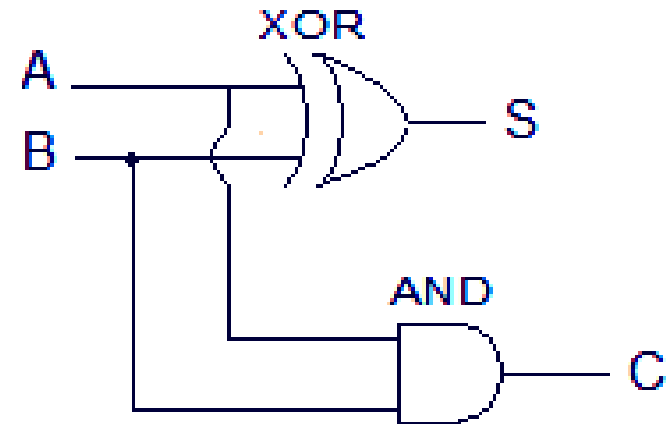
For S:



For C:



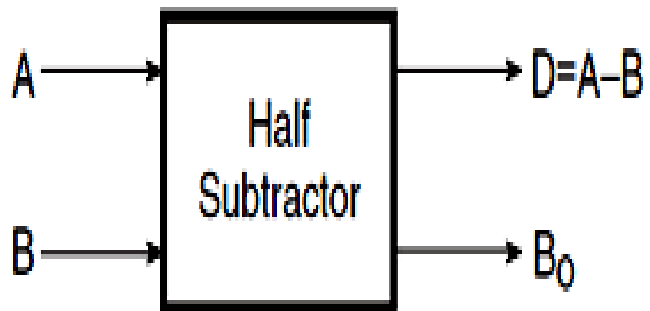
K Maps



Realization

Assignment: Try to realize Full Adder using logic Gates

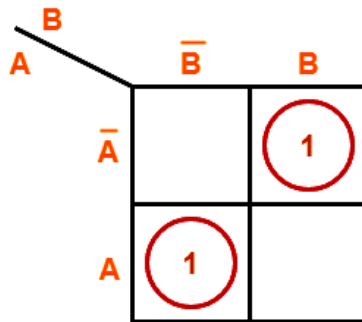
Half and Full Subtractor



A	B	D	B_0
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

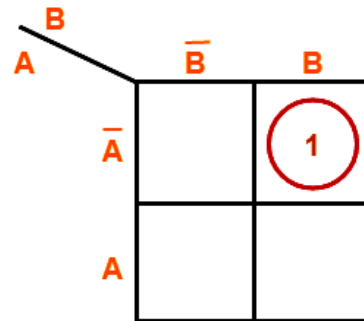
Half and Full Subtractor

For D:



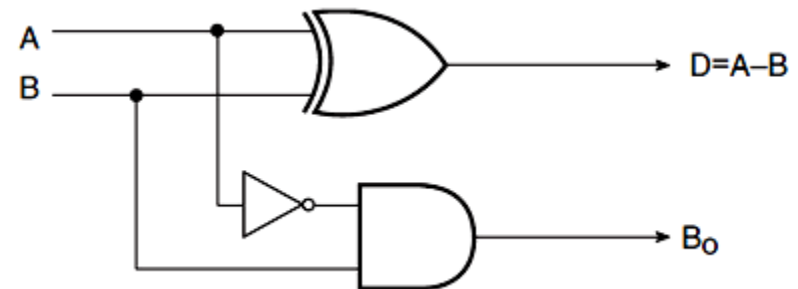
$$D = A \oplus B$$

For b:



$$b = \bar{A}.B$$

K Maps



Assignment: Try to realize Full Subtractor using logic Gates

Combinational Circuits

Combinational Circuit design using various Integrated Circuits (ICs)/ Digital Blocks

- Multiplexer
- Demultiplexer
- Encoder
- Decoder

Multiplexer (MUX)

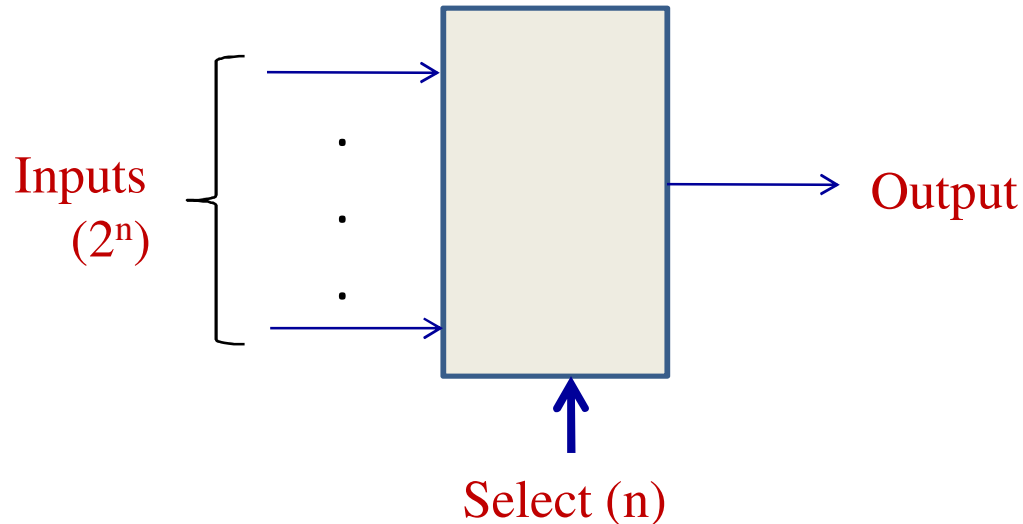
Multiplexer:

Many inputs to One output.

The inputs are selected based on the select line(s).

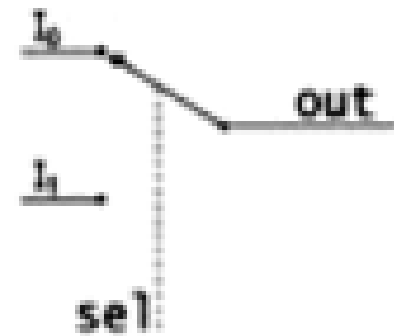
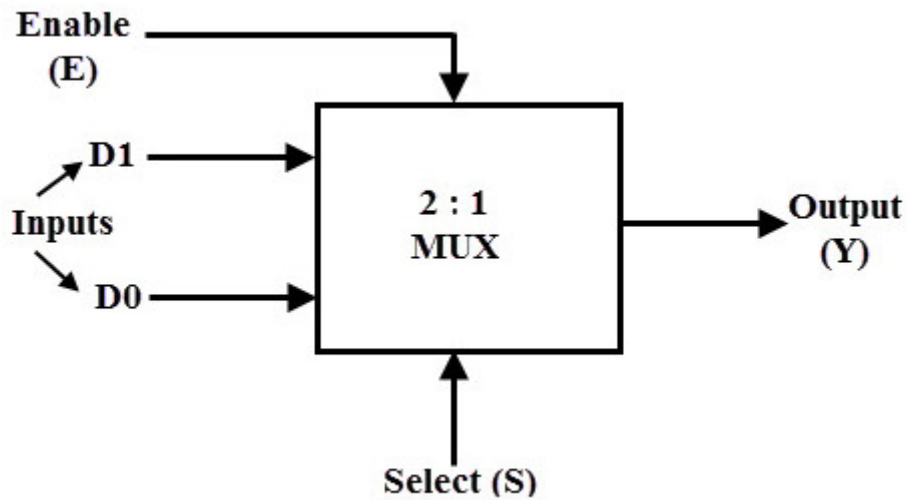
The inputs are in the form of 2^n , where n is the select line.

Used in many switching applications.



Multiplexer Example

2:1 Multiplexer:

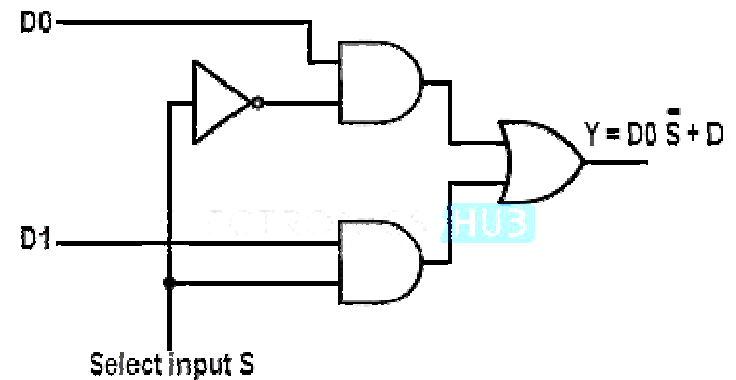
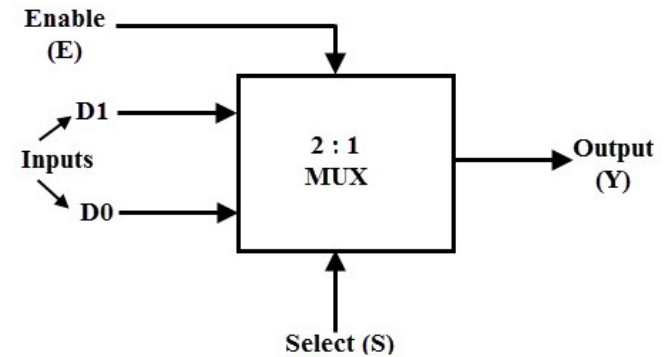


Multiplexer Example

2:1 Multiplexer:

$$Y = D_0 \bar{S} + D_1 S$$

Select	Inputs		Output
0	0	0	0
0	0	1	1
1	1	0	1
1	1	1	1



Assignment: Try to realize 4:1 multiplexer, 8:1 multiplexer

Demultiplexer (DeMUX)

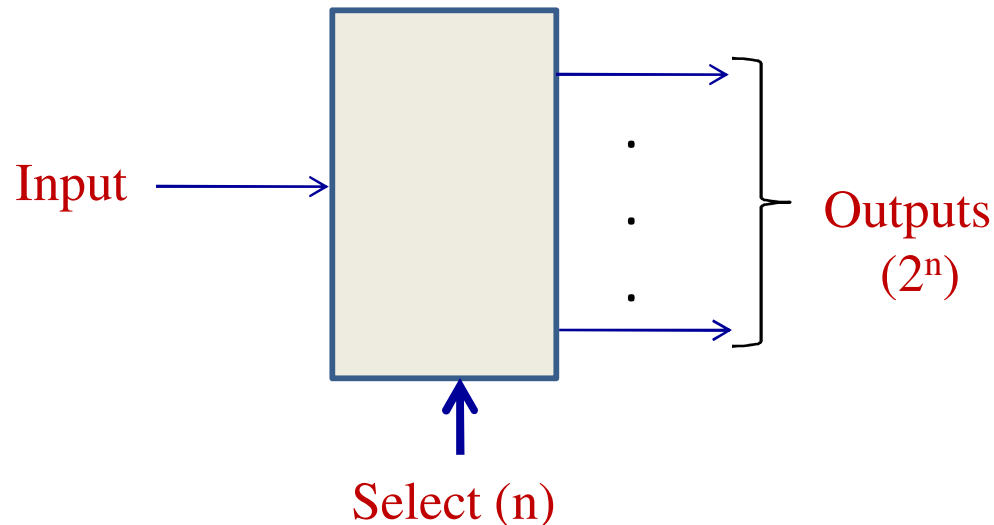
Demultiplexer:

One input to Many outputs.

The Output line is selected based on the select line(s).

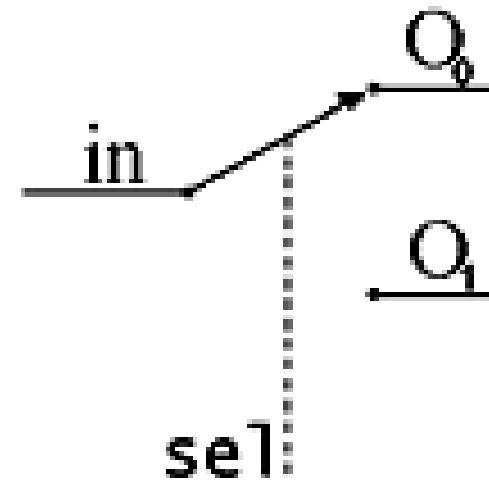
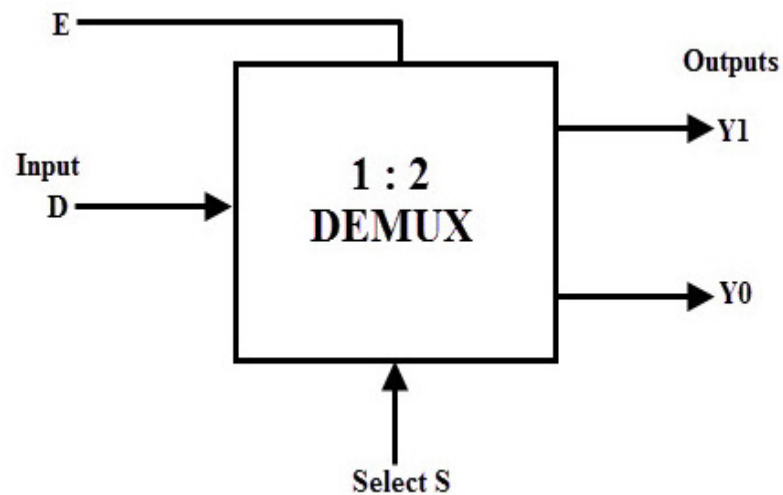
The outputs are in the form of 2^n , where n is the select line.

Used in many switching applications.



Demultiplexer Example

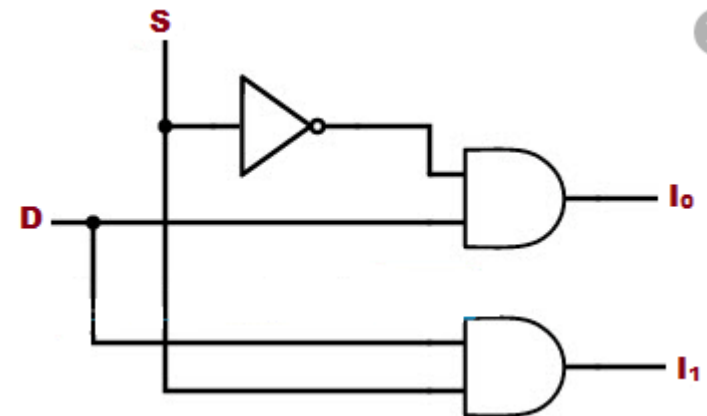
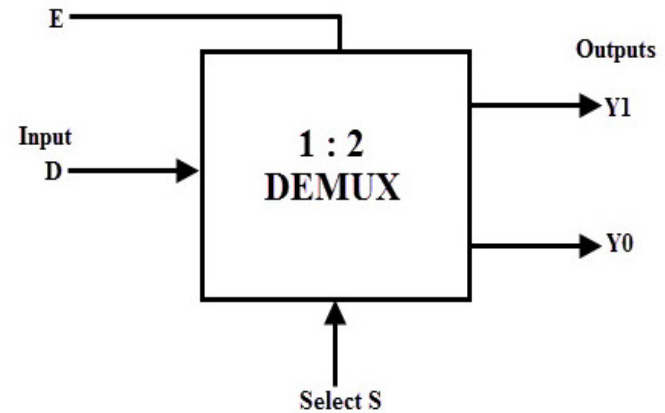
1:2 Demultiplexer:



Demultiplexer Example

1:2 Demultiplexer:

Select	Input	Outputs	
S	D	Y_1	Y_0
0	0	0	0
0	1	0	1
1	0	0	0
1	1	1	0



Assignment: Try to realize 1:4 demultiplexer, 1:8 demultiplexer

Encoder

Encoder:

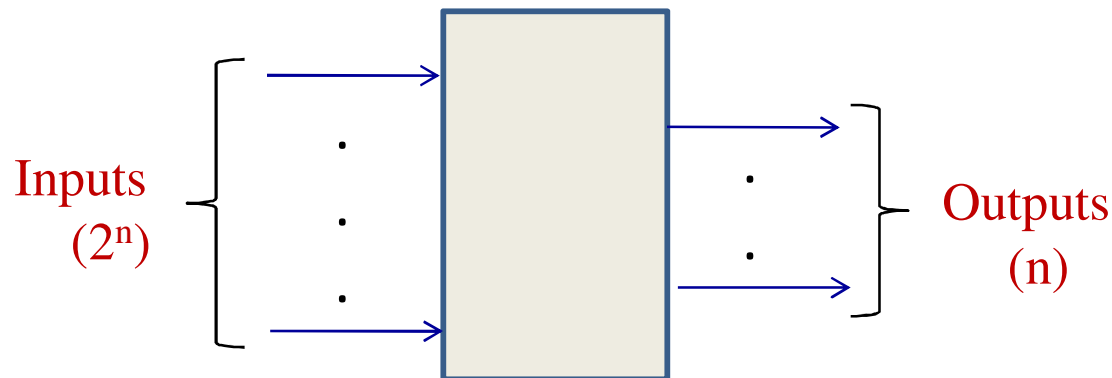
2^n inputs to n outputs.

The Outputs are defined based on the active input line.

Usually only one input is active at a time or otherwise priority line is added to resolve ambiguity.

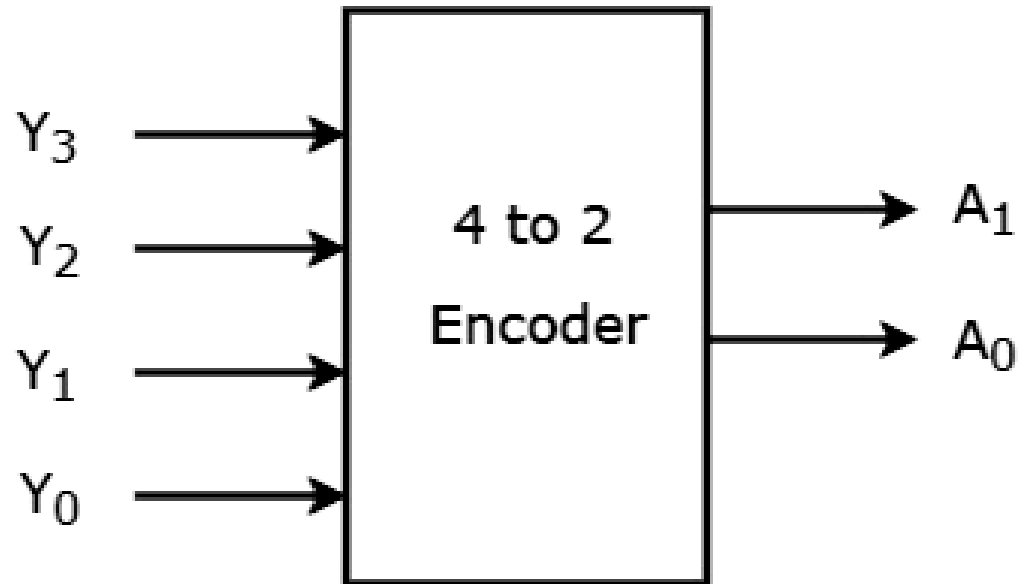
It possesses No select line.

Used in many code converters, modulators, controller designs, etc.



Encoder Example

4:2 Encoder:

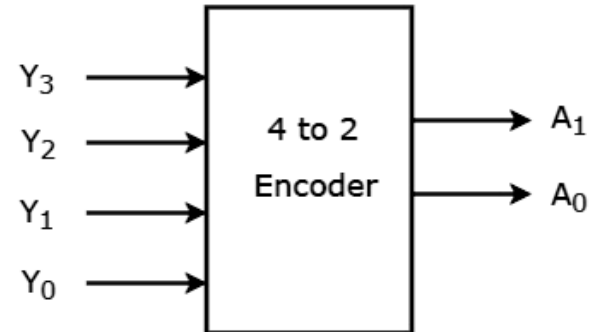


Encoder Example

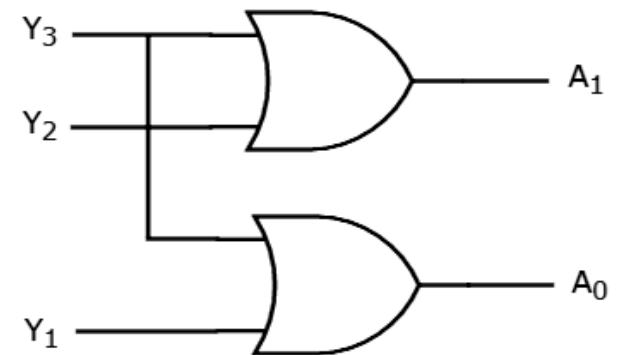
4:2 Encoder:

$$A_1 = Y_3 + Y_2$$

$$A_0 = Y_3 + Y_1$$



Inputs				Outputs	
Y_3	Y_2	Y_1	Y_0	A_1	A_0
0	0	0	1	0	0
0	0	1	0	0	1
0	1	0	0	1	0
1	0	0	0	1	1



Assignment: Try to realize 8:3 Encoder, 8:3 Priority Encoder

Decoder

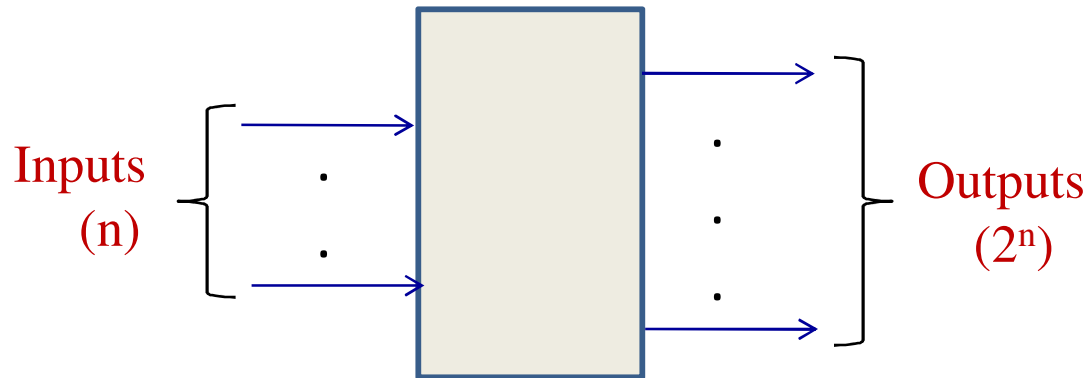
Decoder:

n inputs to 2^n outputs.

Based on inputs, one of the active line goes to logic high (becomes active).

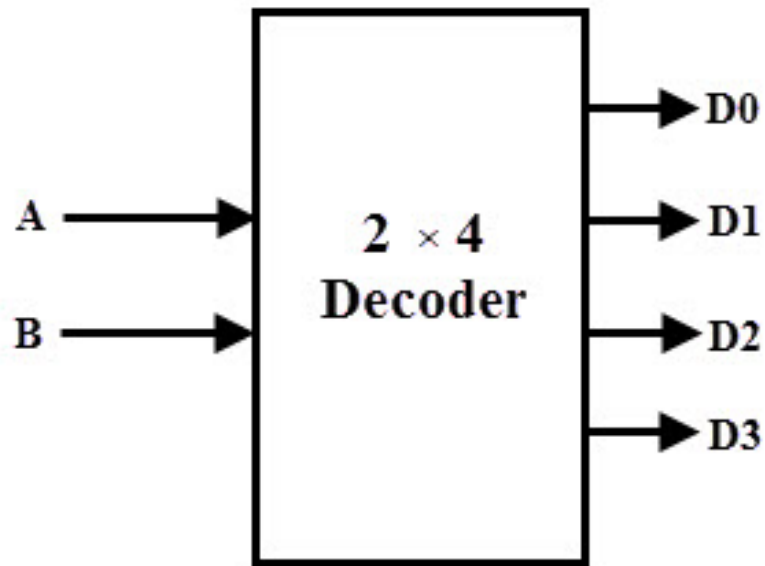
It possesses No select line.

Used in many code converters, demodulators, controller designs, etc.



Decoder Example

2:4 Decoder:



Decoder Example

2:4 Decoder:

Truth Table					
A_1	A_0	D_3	D_2	D_1	D_0
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0

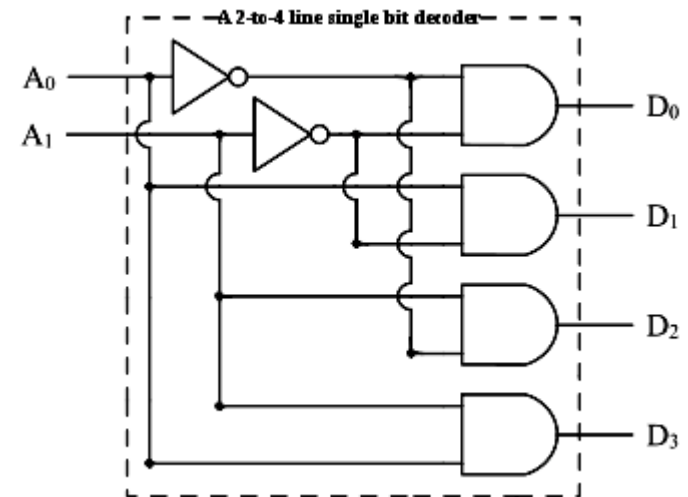
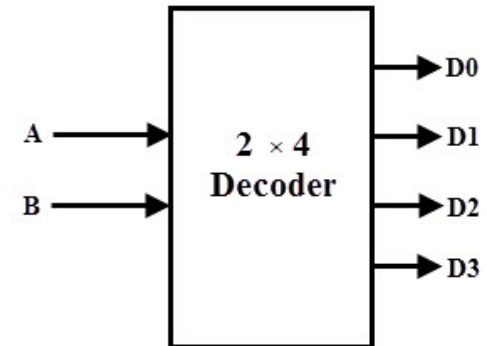
Minterm Equations

$$D_0 = \overline{A_1} \cdot \overline{A_0}$$

$$D_1 = \overline{A_1} \cdot A_0$$

$$D_2 = A_1 \cdot \overline{A_0}$$

$$D_3 = A_1 \cdot A_0$$



Assignment: Try to realize 3:8 Decoder

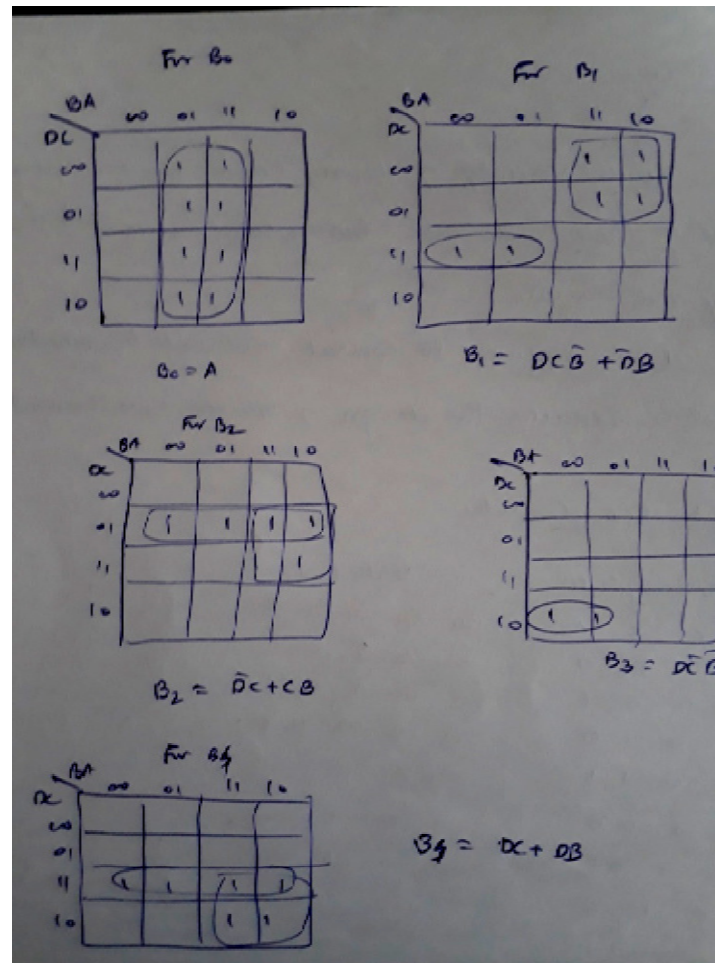
Numericals and Combination Circuit Realization using Multiplexers, Demultiplexers, Encoders and Decoders

Code Converter Example

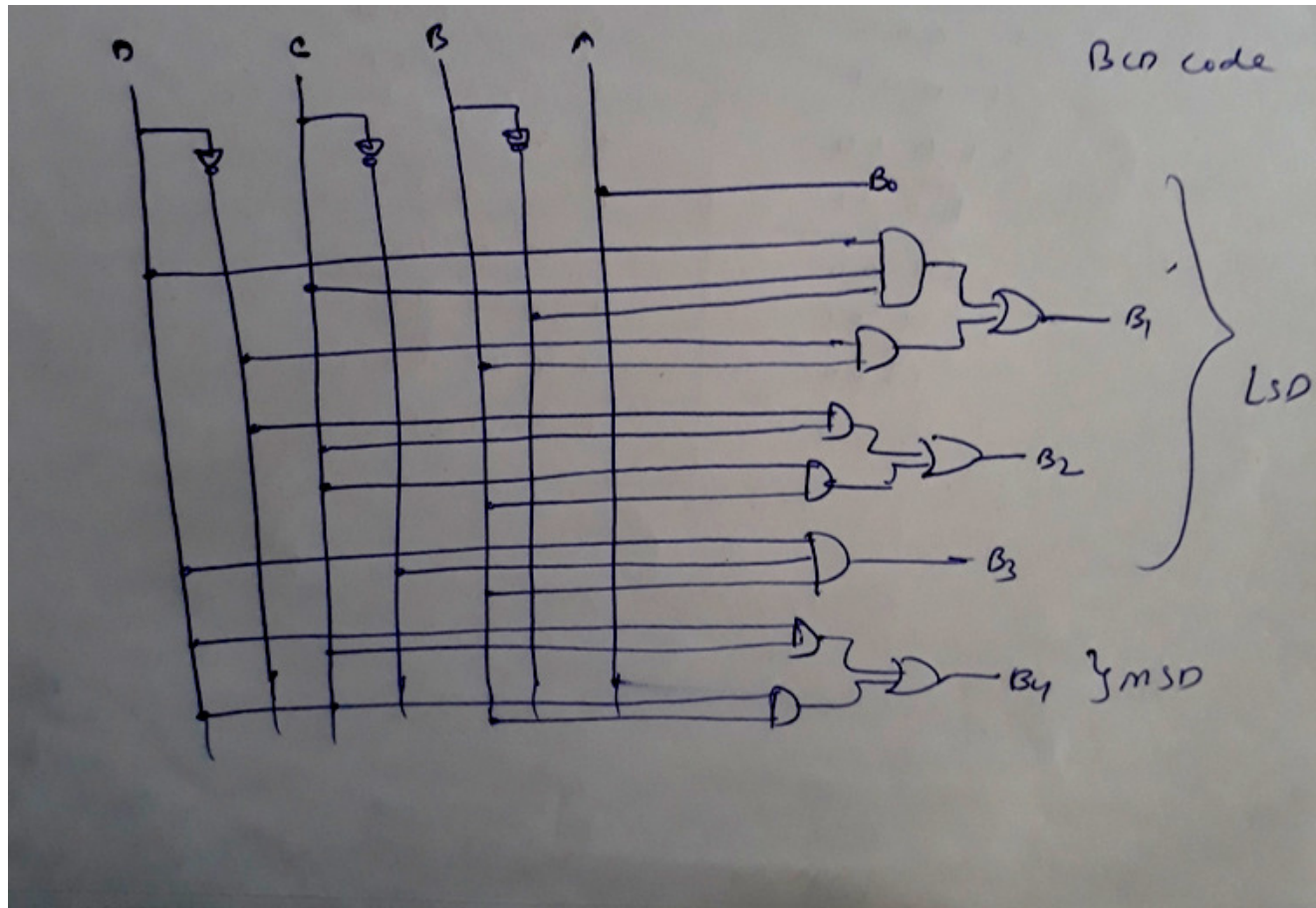
1) Binary to BCD Converter

Binary Code				BCD Code				
D	C	B	A	B ₄	B ₃	B ₂	B ₁	B ₀
0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	1
0	0	1	0	0	0	0	1	0
0	0	1	1	0	0	0	1	1
0	1	0	0	0	0	1	0	0
0	1	0	1	0	0	1	0	1
0	1	1	0	0	0	1	1	0
0	1	1	1	0	0	1	1	1
1	0	0	0	1	0	0	0	0
1	0	0	1	1	0	0	0	1
1	0	1	0	1	0	0	1	0
1	0	1	1	1	0	0	1	1
1	1	0	0	1	1	0	0	0
1	1	0	1	1	1	0	0	1
1	1	1	0	1	1	0	1	0
1	1	1	1	1	1	0	1	1

Code Converter Example



Code Converter Example



Assignment: Practice more numericals from text books.