Logic Design and Computer Organization

Assignment-4

Aim: Design and implement following using multiplexer IC 74153 1) full adder 2) Any three-variable function

IC's Used:

7404 (NOT-gate),74153 (4:1 MUX)

Theory:

Digital Multiplexer:

Multiplexer are combinational digital circuits equating as controlled switches with several data inputs (I0, I1, I2 …) & one single data output ("out"). At any time one of the input is transmitted to output. According to binary signals applied on control pairs to circuit. Usually the number of data inputs is a power of two. Multiplexing is the process of transmitting a large no. of information units over a small no. of channel / digital multiplexer is a combinational large circuit which performs the operation of multiplexing .It selects the operation of multiplexing. It selects the operation of binary information from one of the many input lines & transfer to a single o/p line. Multiplexer is called a data selector or multiposition switch because it selects one of the many input. Selection of a particular line is controlled by a set of a selection lines or selects inputs. The number of select lines depends upon no. of input lines. Generally there is n selects line for m input lines. By applying a particular code on select lines is transmitted on the output lines. Block diagram of MUX is shown at contains 2m input lines m select & one unable input which is used to activate or Dedicate MUX . Depending upon the no. of I/P & O/P lines various types of multiplexers are available. We have 2:1, 4:1, 8:1, 16:1 MUX. Here the first no. indicates the no. of input lines & second no. indicates the no. of output lines

Demultiplexer :

Demultiplexer is a logic used to perform exactly reverse function performed by multiplexer. It accepts a single input and distributes among several outputs. The selection of a particular output line is controlled by a set of selection line. There are n input lines & 2m is the number of selection line whose bit combinations determine which output to be selected.

Difference between Multiplexer, Demultiplexer & Decoder

Point	Multiplexer	Demultiplexer	Decoder
Input	Many input lines	Single input line	Many input line also

			Acts as select line
Output	Single output line	Many output lines	Many output line, Active low output
Select line	$2^m = n$	$n = 2^m$	Enable inputs used

1. Encoders are used to encode given digital number into different numbering format .like decimal to BCD Encoder, Octal to Binary.
2. Decoders are used to decode a coded binary word like BCD to seven segment decoder.
3. Thus encoder and decoder are application specific logic develop, we cannot use any type of input for any encoder and decoder.
4. Need to select input according to encoder and decoder being selected for a particular application as mention in examples above.

Uses of Mux:

- Use for Boolean function implementation.
- Construct a common bus system.
- To select between multiple sources & signal destination.

Advantages:

1) Simplification of logic expression not required.
2) Logic design is simplified.

Disadvantages:

Only one function can be implemented using one MUX. Hence they can't be used in combinational logic circuit which contains many function.

FUNCTION IMPLEMENTATION:

$Y = \sum m (1, 3, 5, 6)$

This expression is in Standard SOP form and it is three variable functions. So, we need to use mux with three select inputs i.e. 8:1 Mux. Already we have implemented 8:1 Mux using IC

74153. For Boolean function in Standard SOP form we connect data inputs corresponding to the minterms present in the given function to Vcc and remaining data inputs to ground.

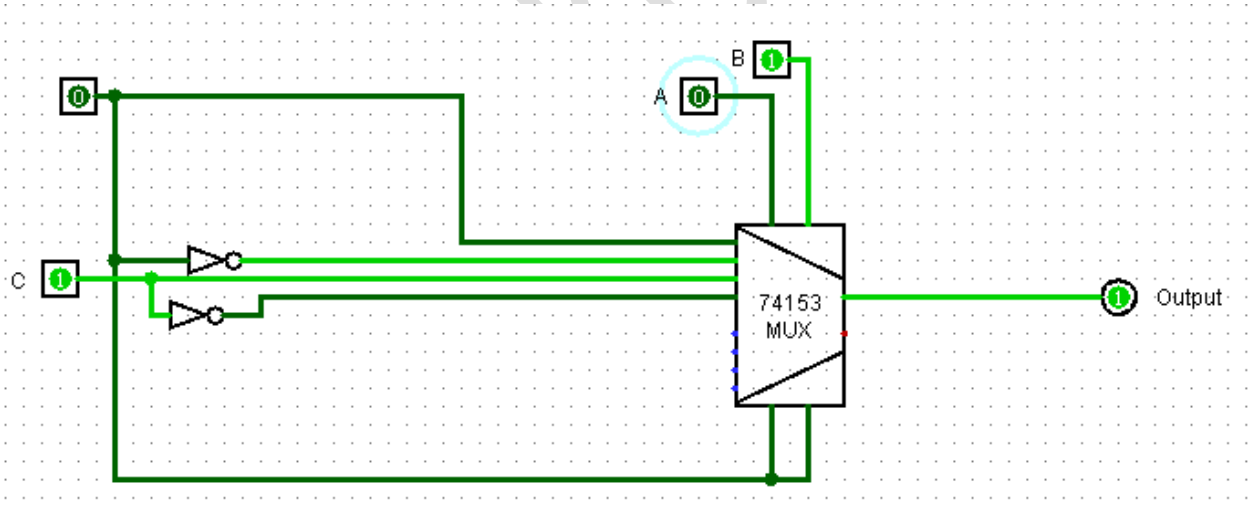
Truth table:

Input			Output
C	B	A	Y
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

Hardware reduction table:

	D_0	**D_1**	**D_2**	**D_3**
C'	0	1	0	1
C	0	1	1	0
Output	0	1	C	C'

Logic Diagram:



Hardware Requirements:

GATE	Quantity	IC	Quantity
MUX	1	74153	1
NOT	1	7404	1

IMPLEMENTATION OF FULL ADDER USING IC 74153:

A full adder is a combinational circuit that forms the arithmetic sum of three input bits. It consists of three inputs and two outputs. Two of these variables denoted by A and B represent

the two significant bits to be added. The third input represents the carry from previous lower significant position.

Truth Table for Design of full adder:

Input			Output	
C	B	A	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Sum= $\sum$m (1,2,4,7),
Carry=$\sum$m (3,5,6,7)

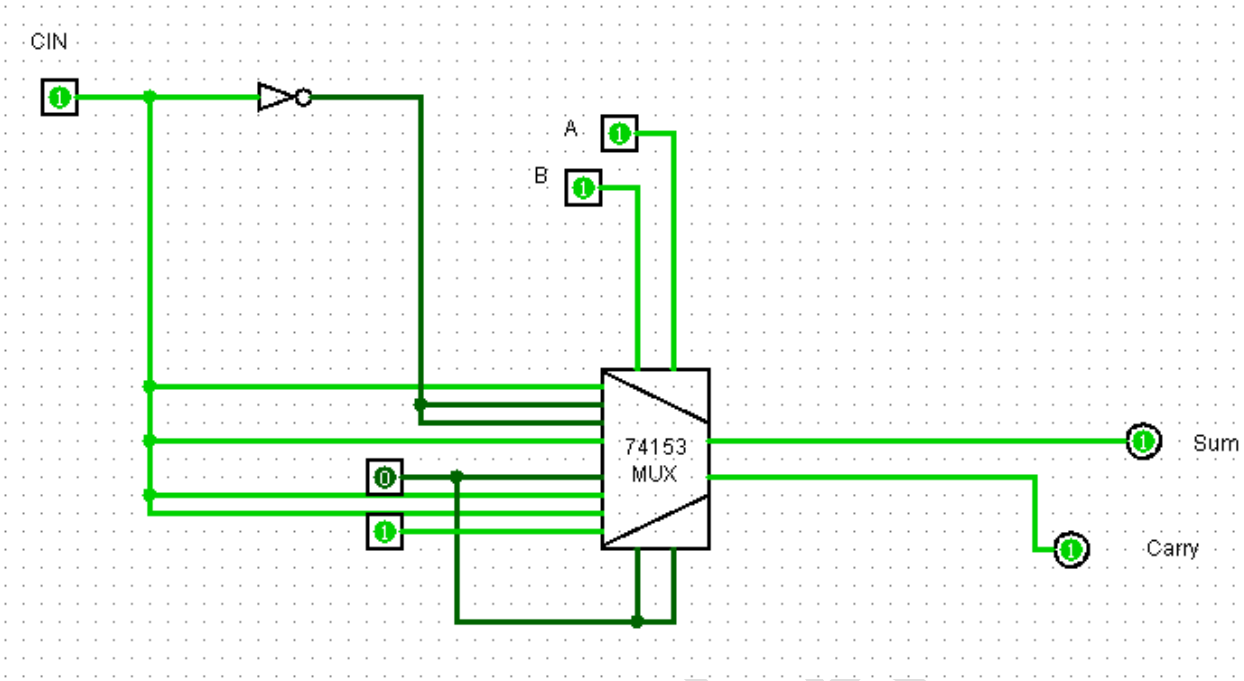
Hardware reduction table for Sum:

	D_0	**D_1**	**D_2**	**D_3**
C'_{in}	**0**	**1**	**1**	**0**
C_{in}	**1**	**0**	**0**	**1**
Output	**C_{in}**	**C'_{in}**	**C'_{in}**	**C_{in}**

Hardware reduction table for Carry:

	D_0	**D_1**	**D_2**	**D_3**
C'_{in}	**0**	**0**	**0**	**1**
C_{in}	**0**	**1**	**1**	**1**
Output	**0**	**C_{in}**	**C_{in}**	**1**

Logic Diagram of Full Adder using IC 74153:



Hardware Requirements:

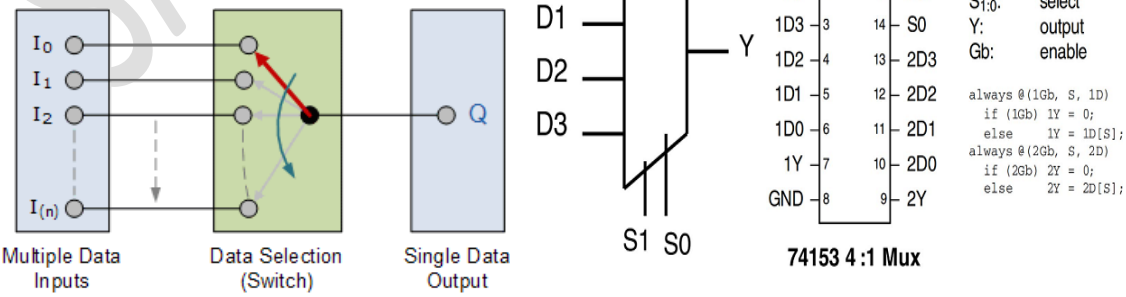
GATE	Quantity	IC	Quantity
MUX	1	74153	1
NOT	1	7404	1

CONCLUSION:

Students will able to design and implement following using multiplexer IC 74153 1) full adder 2) Any three-variable function

FAQ's:

1) Draw IC 74153 Pin Diagram.



2) Difference between MUX and Demux.

Parameters	Multiplexer	Demultiplexer
Definition	Multiplexer refers to a type of combinational circuit that accepts multiple inputs of data but provides only a single output.	The demultiplexer refers to the type of combinational circuit that accepts just a single input but directs it through multiple outputs.
Technique of Conversion	A Multiplexer performs conversion from parallel to serial.	A Demultiplexer performs conversion from serial to parallel.
Common Name	Data Selector	Data Distributor
Operational Principle	Multiplexer works on an operational principle of *many to one*.	Demultiplexer works on an operational principle of *one to many*.
Configuration of Devices	It behaves as a data selector because the multiplexer is an N to 1 device.	It behaves as a data distributor because the demultiplexer is a 1 to N device.
Total Number of Data Inputs	It has multiple inputs of data and signals.	It has a single input of data and signals.
Total Number of Data Outputs	A Multiplexer generates a single output for data and signals.	A Demultiplexer generates multiple outputs for data and signals.
Information Processing	It processes the digital data and info by collecting them from multiple sources and integrating them into a single source as the output.	It collects digital data and info from one single source/channel and then converts it into a set of multiple sources as the outputs.
Type of Digital Setup	The multiplexer acts as a digital switch.	The demultiplexer acts as a digital circuit.
Logic Type	A multiplexer follows a logic type that is combinational.	A demultiplexer also follows a combinational logic type.
End of Usage	In the process of time-division Multiplexing, we use a Multiplexer at the end of the transmitter.	In the process of time-division Multiplexing, we use a Demultiplexer at the end of the receiver.