Lab Report

LAB — 04 CSE — 206

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LAB-04

Name of the experiment: Construct and test various adder and subtractor circuits.

Description:

Adder: An adder is a digital circuit that performs addition of numbers. Adders are two types : (i) Half adder
(ii) Full adder

(i) **Half Adder:** A half adder is a type of adder, That is able to add two binary digits and provide the output plus a carry value. It has ~~to~~two ~~ip~~inputs and two outputs. The common representation uses a XOR logic gate and an AND logic gate.

$\therefore$ Carry $(C) = XY$

$\therefore$ Sum $(S) = X'Y + XY' = X \oplus Y$

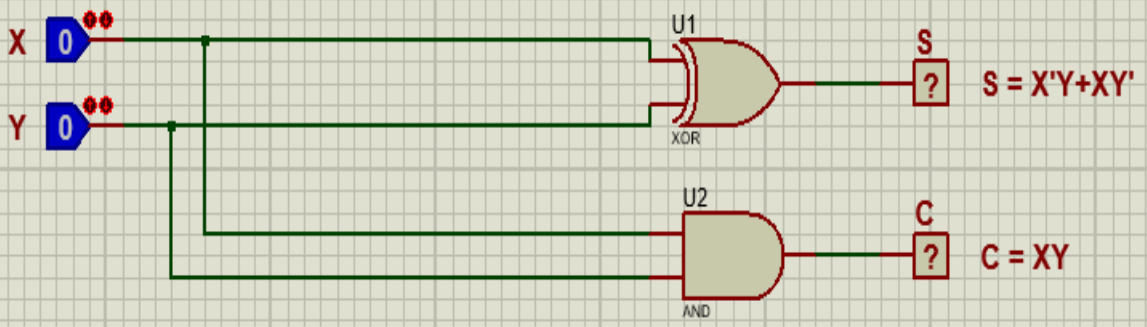
Truth Table:

X	Y	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

Equipments:

(i) LOGICSTATE
(ii) LOGICPROBE
(iii) XOR Gate
(iv) AND Gate

Half Adder



Full Adder: A full adder circuit is central to most digital circuits that perform addition. It is so called because it adds together two binary digits, plus a carry in digit to produce a sum and carry out digit. It has three i/p inputs and two outputs.

$\therefore$ Carry $(C) = XY + XZ + YZ$

$\therefore$ Sum $(S) = X'Y'Z + X'YZ' + XY'Z' + XYZ$

It can also be written with two half adders

Then, Carry, $(C) = XY + Z(X+Y)$

Sum, $(S) = Z \oplus (X \oplus Y)$

Truth Table:

X	Y	Z	C	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Equipments:

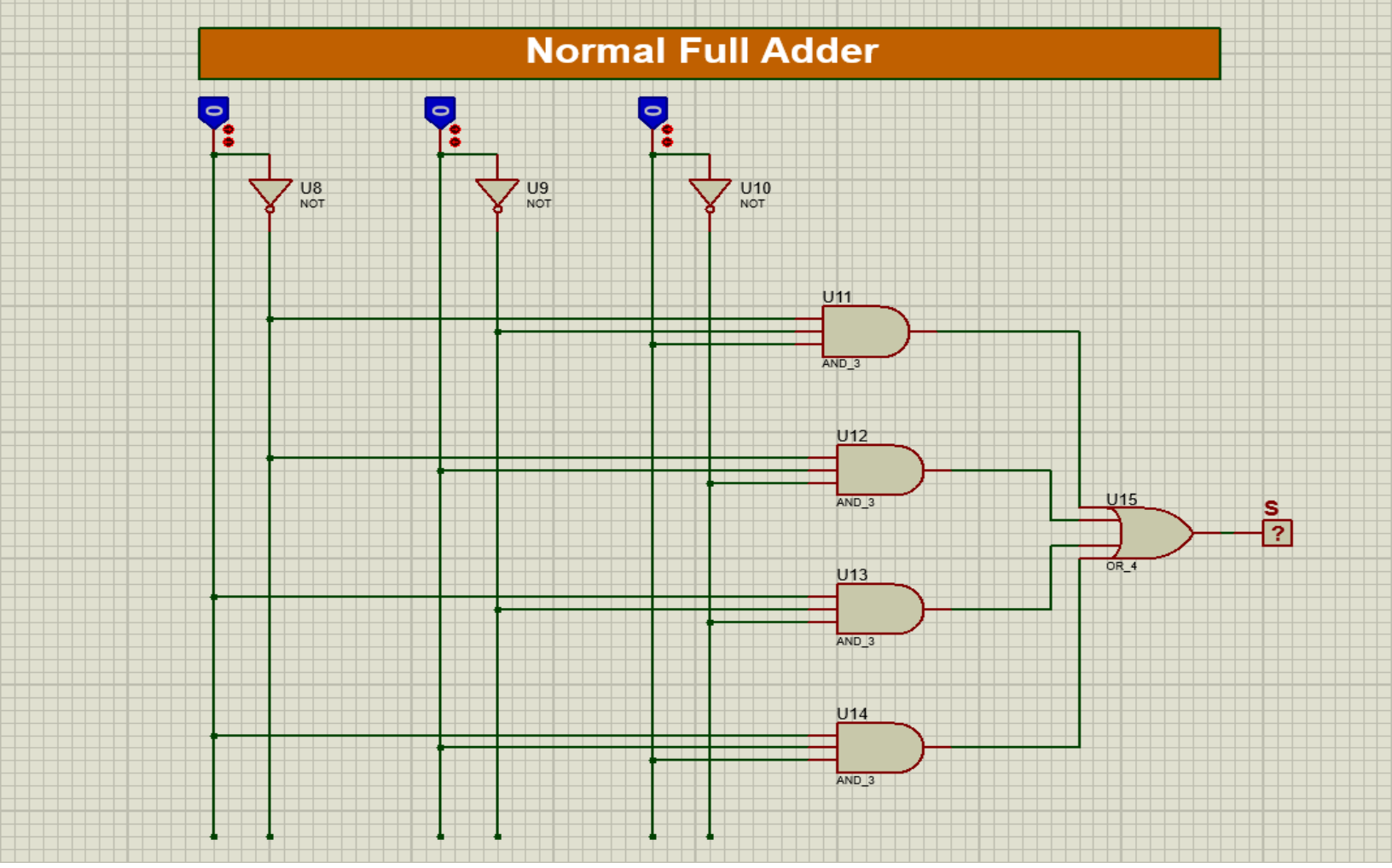
Normal Full Adder:

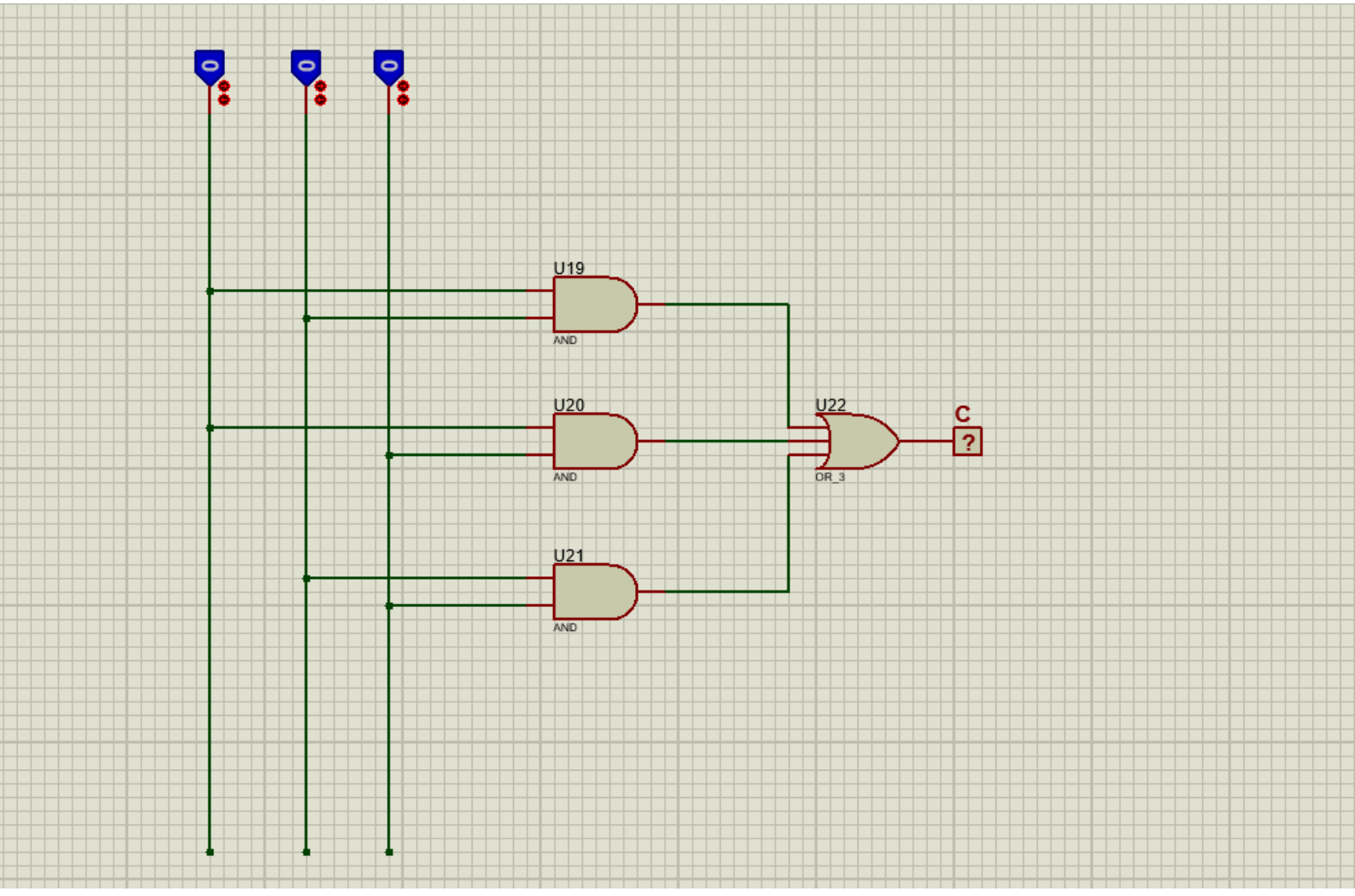
(i) LOGIC PROBE
(ii) LOGIC STATE
(iii) 3 input AND Gate
(iv) 4 input OR Gate
(v) 3 input OR Gate
(vi) 2 input AND Gate

Full Adder with Half adders:

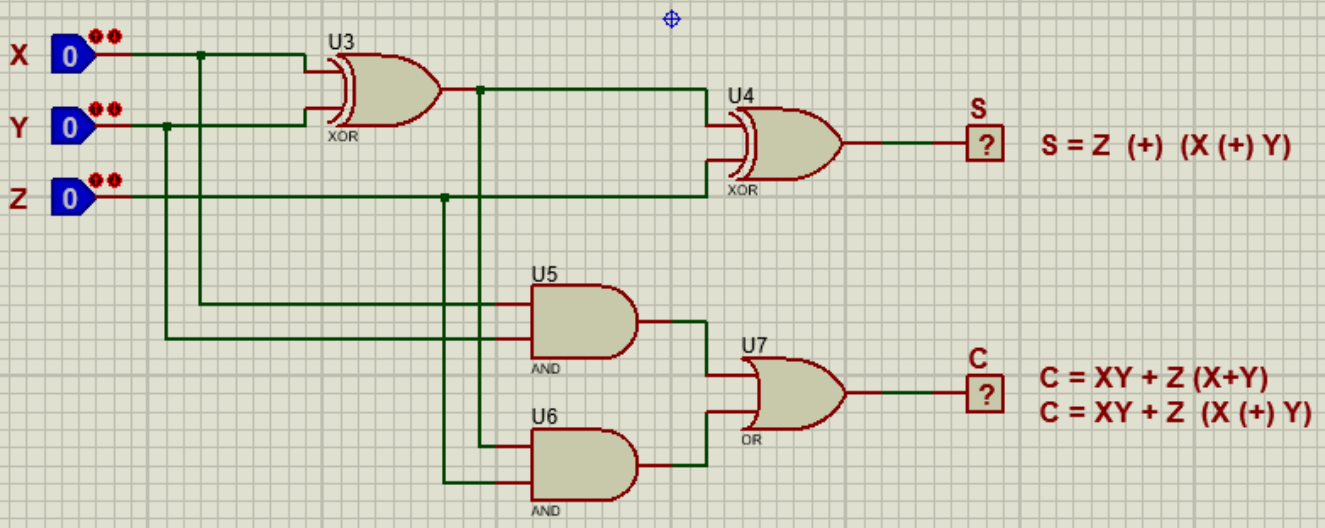
(i) LOGIC PROBE
(ii) LOGIC STATE
(iii) XOR Gate
(iv) AND Gate
(v) OR Gate

Normal Full Adder





Full adder with two half adders



Subtractor: Subtractor circuits take two binary numbers as input and it subtract one number from another. It gives two outputs. (Difference and Borrow).

There are two types of subtractor:

(i) Half Subtractor

(ii) Full Subtractor

(i) Half Subtractor: The half subtractor is a combinational circuit which is used to perform subtraction of two bits. It has two inputs and two outputs. It doesn't consider the previous borrow.

$\therefore$ Borrow $(B) = X'Y$

$\therefore$ Difference $(D) = X'Y + XY'$

$= X \oplus Y$

= Adder's Sum

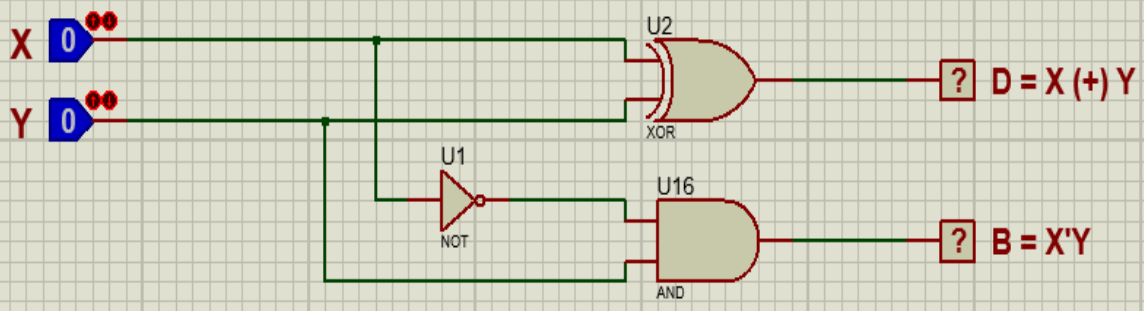
Truth Table:

X	Y	B	D
0	0	0	0
0	1	1	1
1	0	0	1
1	1	0	0

Equipments:

(i) LOGICSTATE
(ii) LOGICPROBE
(iii) XOR Gate
(iv) NOT Gate
(v) AND Gate.

Half Subtractor



Full Subtractor: A full subtractor performs subtraction involving three bits (X, Y, Z). Here (X, Y) are literal and Z is previous borrow. It has three inputs and two outputs. It consider the previous borrow.

$\therefore$ Borrow, $(B) = X'Z + X'Y + YZ$

$\therefore$ Difference $(D) = X'Y'Z + X'YZ' + XY'Z' + XY'Z + XYZ$

$=$ Sum of full adder.

$\therefore$ It can also be written with two half subtractors.

Then,

$$\text{Borrow}, (B) = \bar{X}Y + Z(\overline{X \oplus Y})$$

$$\text{Difference}, (D) = Z \oplus (X \oplus Y)$$

Truth Table:

X	Y	Z	B	D
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	1	0
1	0	0	0	1
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Equipments:

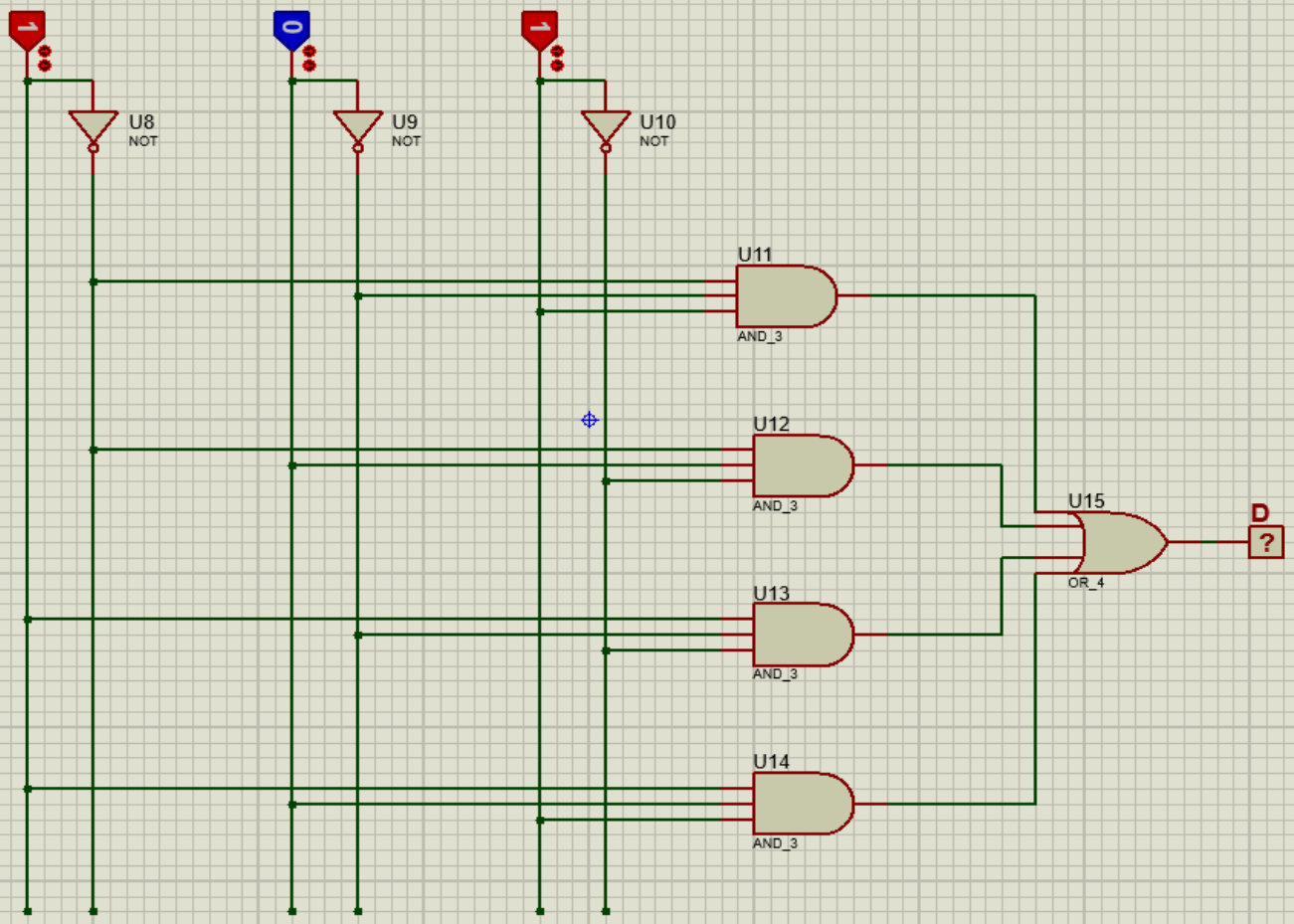
Normal Full Subtractor

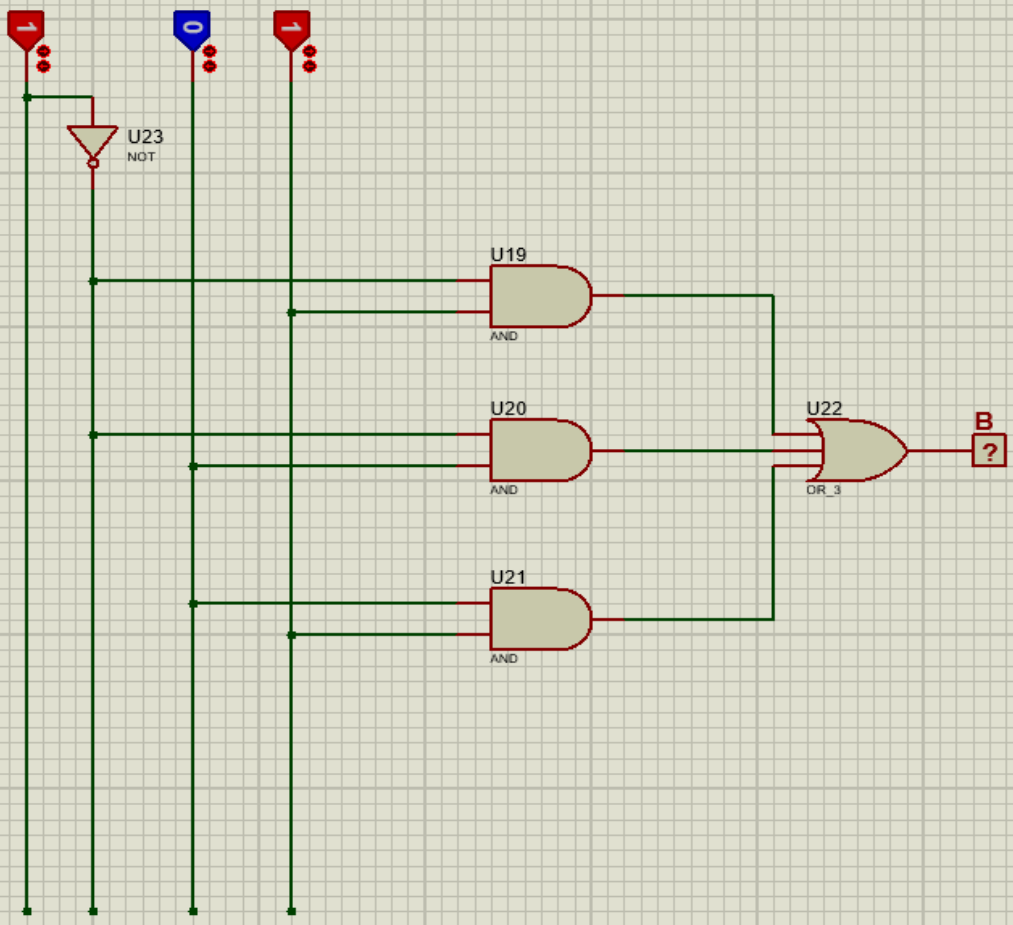
(i) LOGICPROBE
(ii) LOGICSTATE
(iii) AND Gate
(iv) NOT Gate
(v) 3 input OR Gate

Full Subtractor with two half subtractor

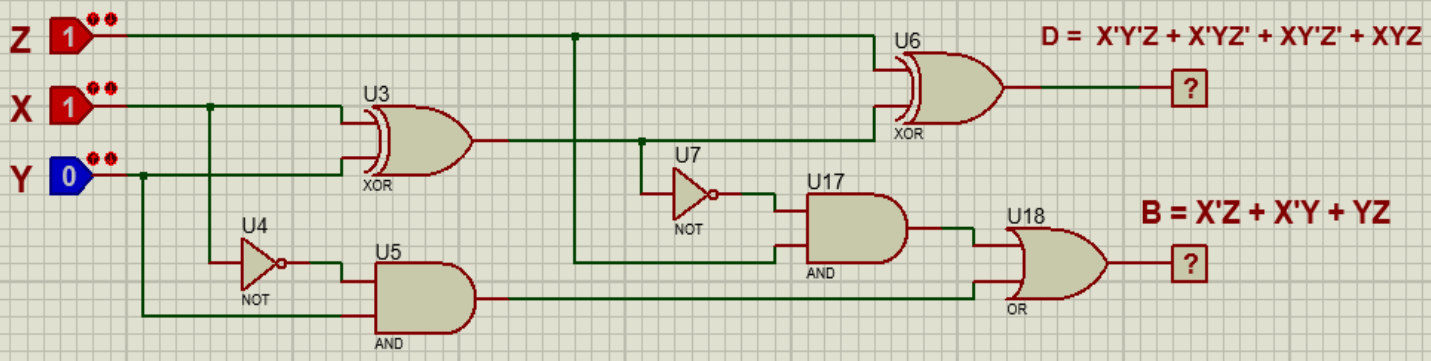
(i) LOGICSTATE
(ii) LOGICPROBE
(iii) XOR Gate
(iv) NOT Gate
(v) AND Gate
(vi) OR Gate

Normal Full Subtractor





Full subtractor with two half subtractors



Conclusion:

(i) We learnt how to implement Adder circuit.

(ii) We learnt how to implement Subtractor circuit.

(iii) We learnt how to add two binary bits and find out carry and sum.

(iv) We learnt how to subtract two or three bits and find out Borrow and the Difference.

(v) We learnt implementation of full adder using half adders.

(vi) We learnt implementation of full subtractor using half subtractors.

THE END