Experiment No. : 05

Aim : To study the Gate Level Analysis of Half Subtractor and Full Subtractor.
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Objective: To study the output characteristics half-subtractor and full-subtractor and stimulate it using LTSPICE software.

Theory:

Half-Subtractor

A conventional Half-subtractor circuit is a combinational circuit that can be used to subtract one binary digit from another to produce a Difference output and a Borrow output. Functionally, the half subtractor consists of a 2 input XOR Gate, an INVERTER and a 2 input AND gate. The Borrow output here specifies whether a "1" has been borrowed to perform the subtraction.

The Boolean expression for the two output variables are given by the equations.

Difference = A'B+AB'

Borrow = A'B

A	B	Bout	Diff	Comment
0	0	0	0	0-0=0,No borrow
0	1	1	1	0-1=-1,borrow 2, so:2-1=1
1	0	1	0	1-0=1, No borrow
1	1	0	0	1-1=0, No borrow

Full-Subtractor

A 1- Bit full Subtractor is a combinational circuit that performs a subtraction between two binary bits and "1" may have been borrowed by a lower significant stage. This circuit has three inputs and two outputs. Let the three inputs be A, B and Bin and Borrow and Difference are two outputs of the 1-bit Subtractor and denoted by Bout and Diff respectively.

A	B	Bin	Bout	Diff	Comment
0	0	0	0	0	0-0-0=0, No borrow
0	0	1	1	1	0-0-1=-1, borrow 2,so:2-1=1
0	1	0	0	1	1-0-0=1, No borrow
0	1	1	0	0	1-0-1=0, No borrow
1	0	0	1	1	0-1-1=-1,(bin=1),borrow2,so:2-1=1
1	0	1	1	0	0-1-1=-2,borrow 2,so:2-2=0
1	1	0	0	0	1-1-1=0,No borrow
1	1	1	1	1	1-1-1=-1,borrow 2,so:2-1=1

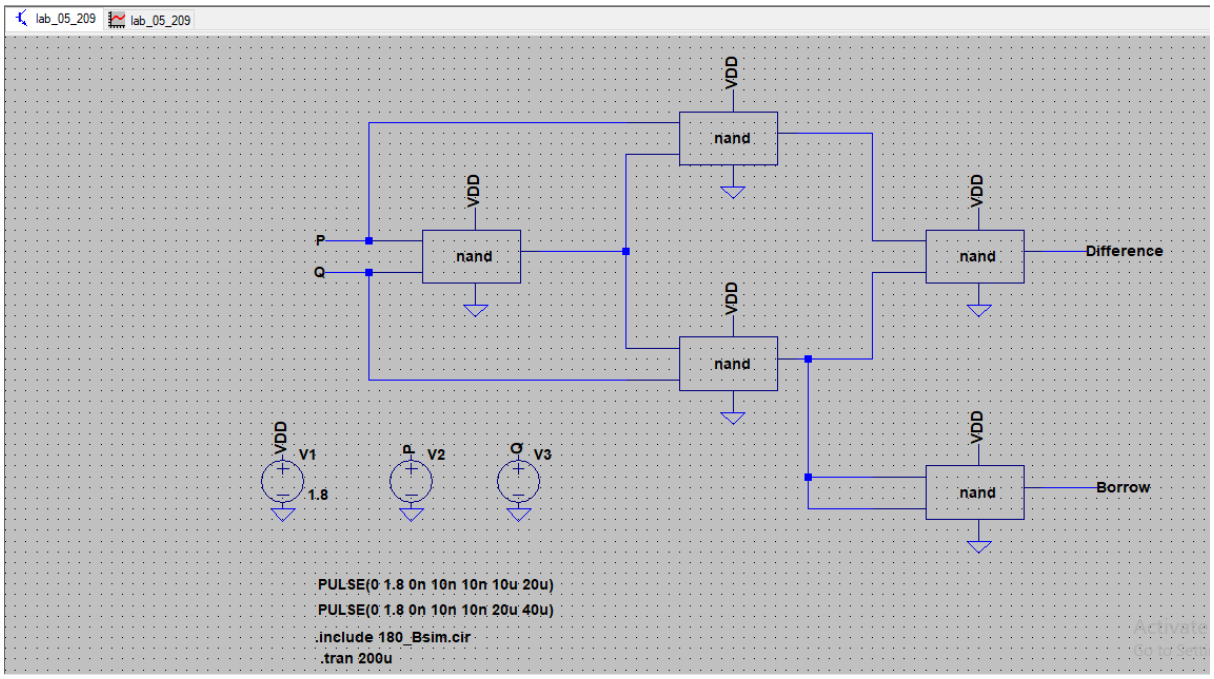
The Boolean expression for the two output variables are given by the equations.

Differences = A xor B xor Bin

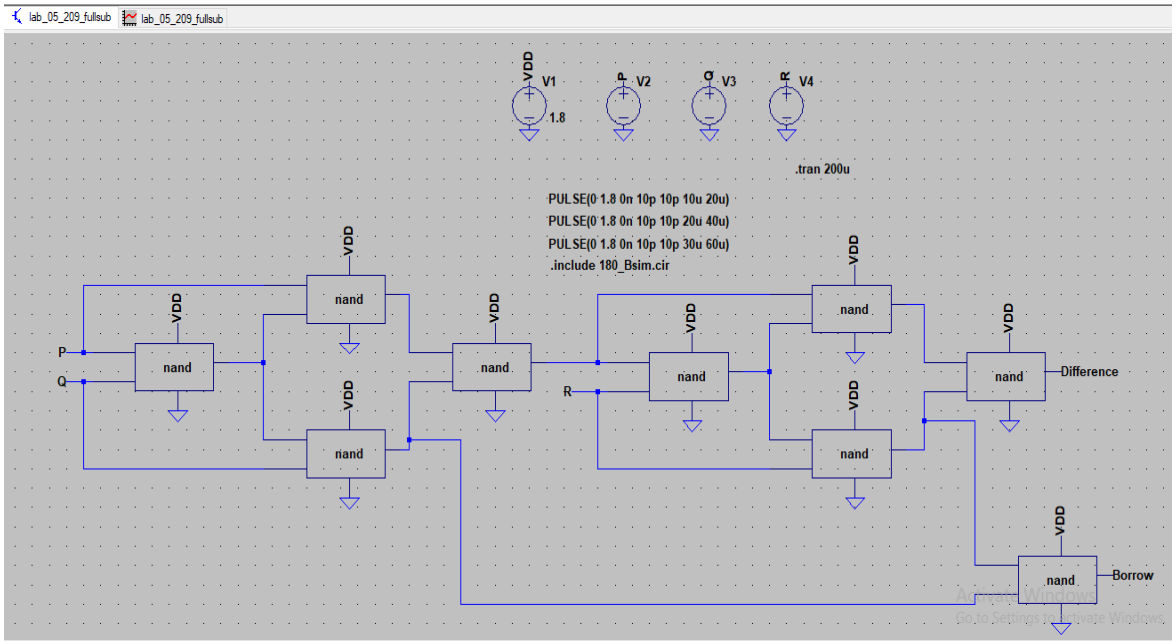
Borrow = A'B+A'Bin+BBin

Schematic:

1) Half_Subtractor

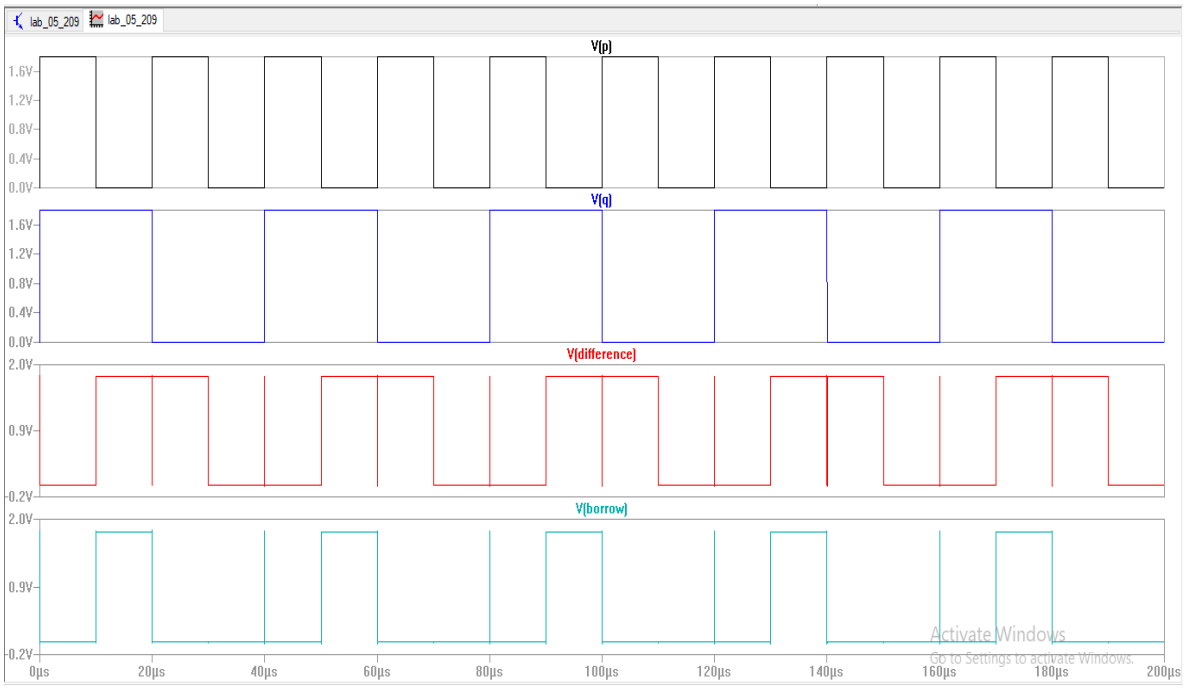


2) Full_Subtractor

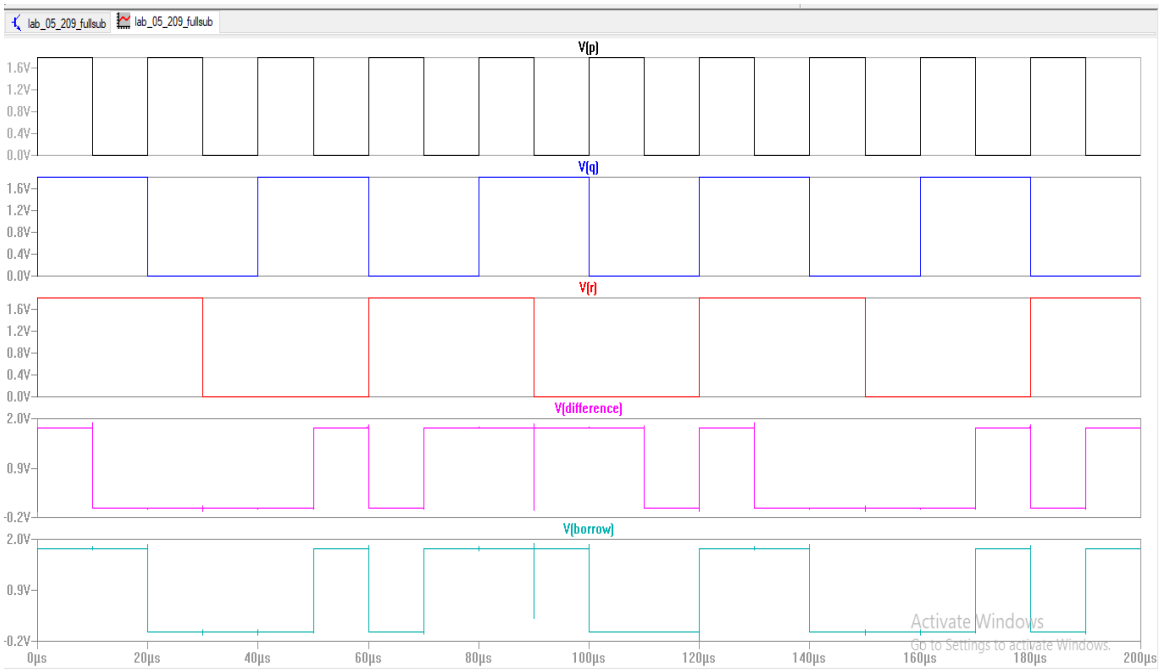


Waveforms:

1) Half_Subtractor Waveforms



2) Full_Subtractor Waveforms



Result / Conclusion :

Thus we successfully studied output characteristics of Half Subtractor and Full Subtractor and simulated in LTSPICE software.

Roll No. :	209	**Marks out of 10**		**Signature :**
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