Experiment No: 01

21118

Title: Binary adder & substractor circuits

Objectives

1) Design & implement full adder circuit using basic gates & universal logic gates.
2) Design & implement full substractor circuit using basic gates & universal logic gates.

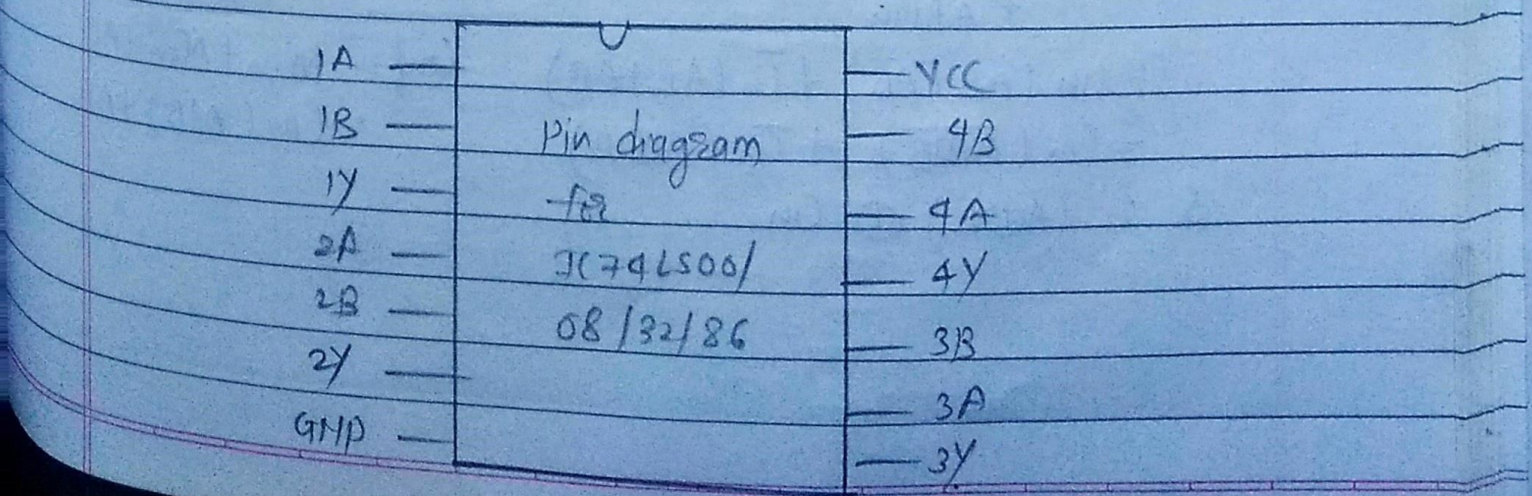
Apparatus

Digital board, GP-4-batch chord, IC74LS86, IC74L32, IC74LS08/ IC74LS04 & IC74LS00 & required logic gates.

Theory

1) Binary adder & substractor are a combinational logic circuits which is used to perform binary addition & substraction.
2) Full adder has three inputs & two outputs. The first two inputs are A & B & third input is an input array designed as Cin. When full adder logic is defined we will be able to string eight of them together to create a byte-wide adder & cascade the carry bit from one adder to the next.
3) The full substractor is a combinational circuit with three inputs A, B, C & two output D & $\overline{C}$. A is the 'minuend', B is 'subtrahend', C is the 'borrow' produced by the previous stage, D is the difference output & $\overline{C}$ is the borrow output.

Pin Diagram



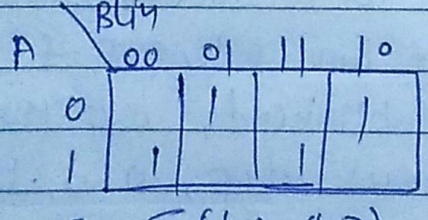
proceduse

1) Make the connections as per the logic circuit of full adder circuit & verify it's truth table.
2) Make the connections as per the logic of full Substractor ckt & verify it's truth table

Design of full Adder:

Sl no.	Input			Output	
	A	B	C_{in}	Sum	Carry
0	0	0	0	0	0
1	0	0	1	1	0
2	0	1	0	1	0
3	0	1	1	0	1
4	1	0	0	1	0
5	1	0	1	0	1
6	1	1	0	0	1
7	1	1	1	1	1

k-map simplification:



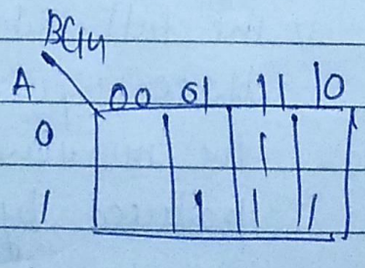
$S = \Sigma(1,2,4,7)$

$S = A\bar{B}\bar{C}_{in} + \bar{A}B\bar{C}_{in} + ABC_{in} + \bar{A}\bar{B}C_{in}$

$= C_{in}(AB + \bar{A}\bar{B}) + \bar{C}_{in}(A\bar{B} + \bar{A}B)$

$= C_{in}(\overline{A \oplus B}) + \bar{C}_{in}(A \oplus B)$

$S = (A \oplus B) \oplus C_{in}$

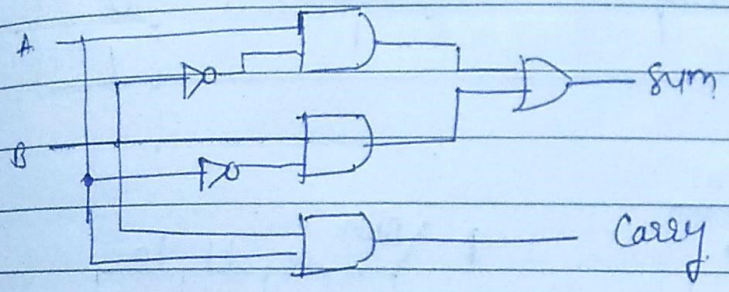


$Cout = (A, B, C_{in}) = \Sigma(3,5,6,7)$

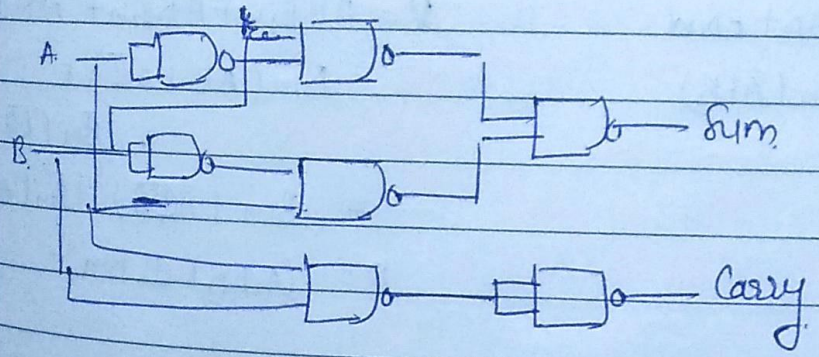
$Cout = BC_{in} + AC_{in} + AB$

$= C_{in}(A+B) + AB$

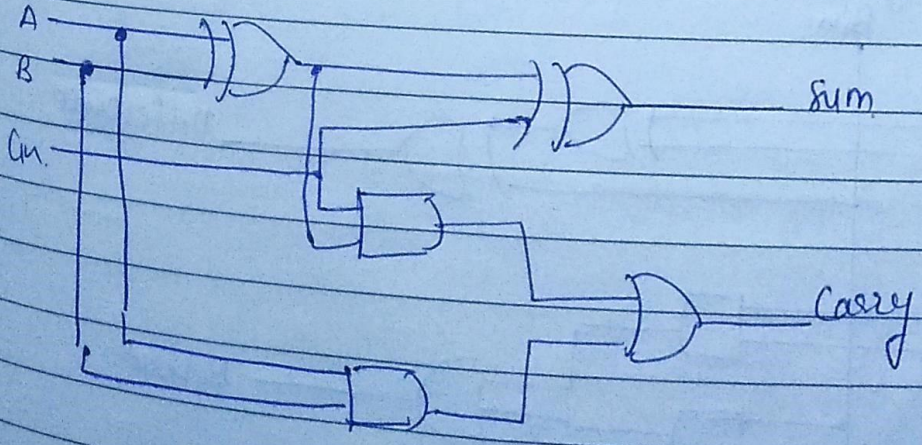
HA using basic gates



HA using NAND gate:



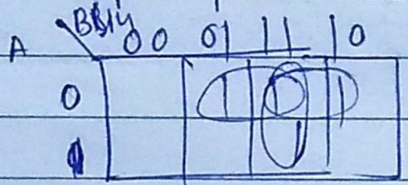
Full adder:



Design of full substractor

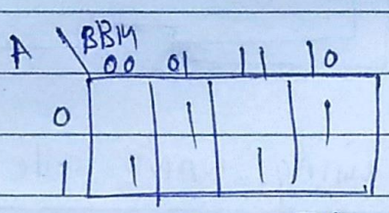
Dec eqn	input A	B	Bin	output difference	Borrow
0	0	0	0	0	0
1	0	0	1	1	1
2	0	1	0	1	1
3	0	1	1	0	1
4	1	0	0	1	0
5	1	0	1	0	0
6	1	1	0	0	0
7	1	1	1	1	1

K-map simplification:



Bout = $\bar{A}B_{in} + A\bar{B} + BB_{in}$

$= A\bar{B} + B_{in}(\bar{A}+B)$



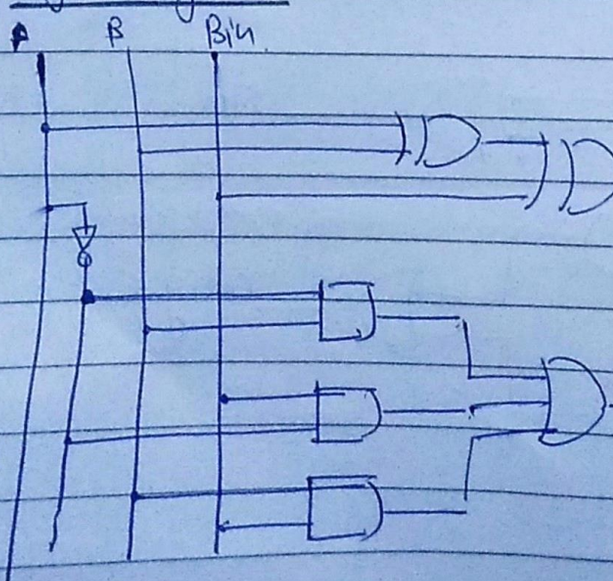
D = $AB\bar{B}_{in} + \bar{A}\bar{B}B_{in} + ABB_{in} + \bar{A}B\bar{B}_{in}$

$= B_{in}(AB + \bar{A}\bar{B}) + \bar{B}_{in}(A\bar{B} + \bar{A}B)$

$= B_{in}(\overline{A \oplus B}) + \bar{B}_{in}(A \oplus B)$

$D = (A \oplus B) \oplus B_{in}$

Logic diagram



logic gates / MSI device required for implementation

Sr.No	Title	Name of IC	No. of gates req.	IC req
01	full adder circuit using basic logic gates	HEX Inverter 7404	1	1
		Quad 2-i/p AND 7408	6	2
		Quad-2-i/p OR-7432	3	1
	full adder circuit using universal logic gates	~~HEX Inverter 7404~~	.	3
		Quad 2-i/p AND 7408	9	3
		Quad-2-i/p NOR 7402	9	
02	full substractor circuit using basic logic gates	HEX inverter 7404	1	1
		Quad 2-i/p AND 7408	1	1
		Quad-2-i/p OR-7432	3	1

Conclusion:

Successfully designed & implemented full adder using basic gates & universal gates.

Successfully designed & implemented full Substractor using basic gates & universal gates.