University of Engineering & Management, Kolkata

Subject Name: Computer Organization & Architecture Laboratory

Subject Code: PCCCS492

ASSIGNMENT – 3

3.1. TITLE: Design of a 4-bit Arithmetic Circuit and verify the truth table.

3.2. APPARATUS REQUIRED:

a. Logic trainer kit
b. Breadboard
c. Single strand wires
d. Integrated circuit's (IC 4008 (4-Bit Binary Full Adder), IC 4539 (4:1 Multiplexer), IC 4069 (Inverter))

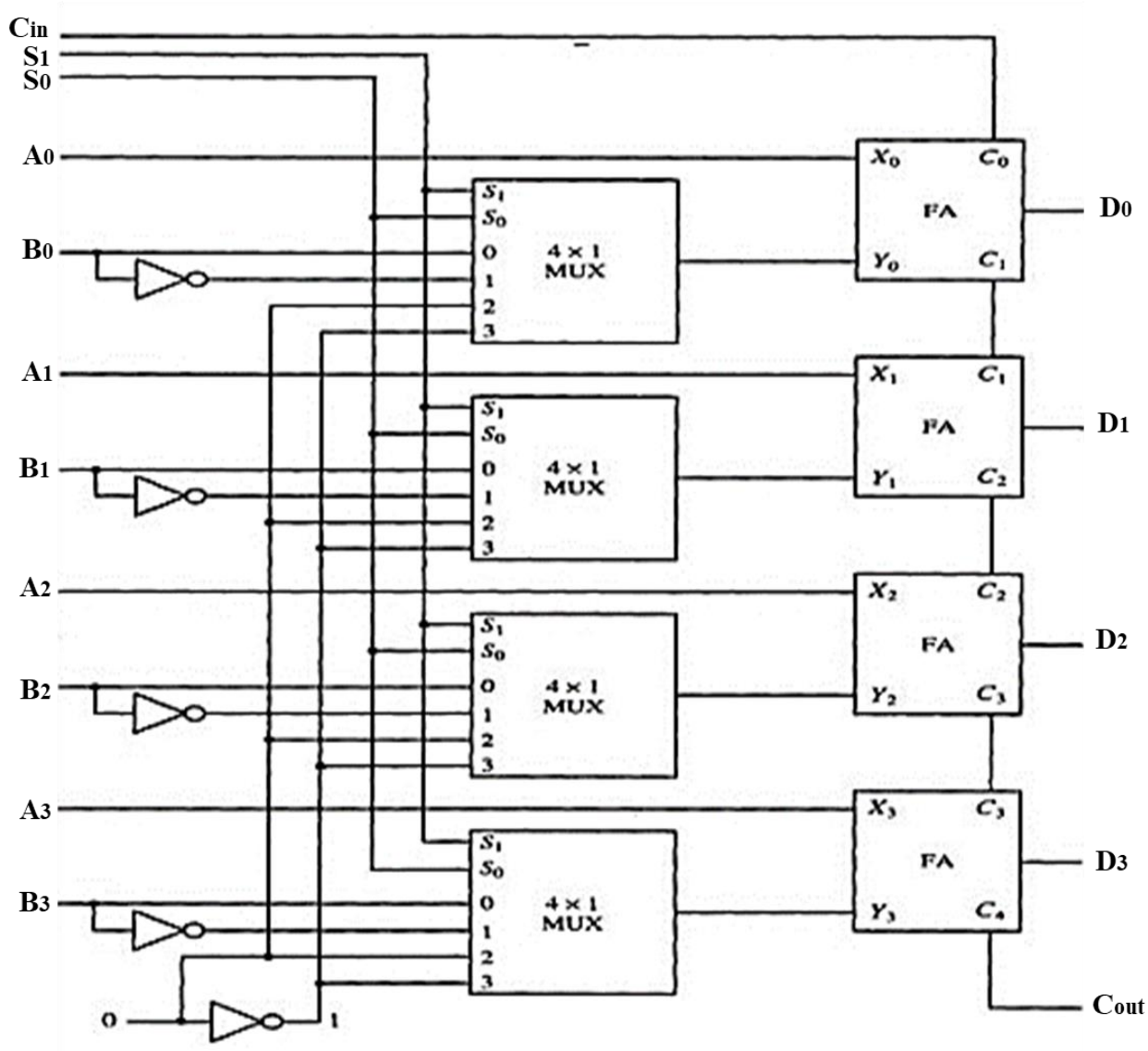
3.3. THEORY:

3.3.1. Arithmetic circuits can perform seven different arithmetic operations using a single composite circuit.

It uses a full adder (FA) to perform these operations. A multiplexer (MUX) is used to provide different inputs to the circuit in order to obtain different arithmetic operations as outputs.

3.3.2. 4-bit Arithmetic Circuit:

Consider the following 4-bit Arithmetic circuit with inputs A and B. It can perform seven different arithmetic operations by varying the inputs of the multiplexer and the carry (C_{in}). To design this circuit we require 4 Multiplexer (4:1), 4 Full adder (or a ripple carry adder circuit), 5 NOT Gate (Inverter).

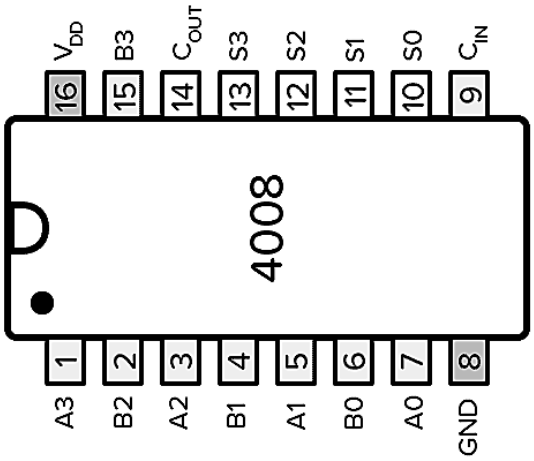


3.3.3. Truth Table for the above Arithmetic Circuit:

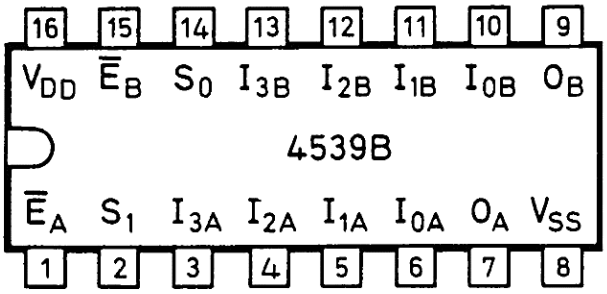
S0	S1	Cin	MUX Output	Full Adder Output	Mode
0	0	0	B	D=A+B	Add
0	0	1	B	D=A+B+1	Add with carry
0	1	0	$\overline{B}$	D=A+$\overline{B}$+0 = A-B-1	Subtract with borrow
0	1	1	$\overline{B}$	D=A+$\overline{B}$+1 = A-B-1+1 = A-B	Subtract
1	0	0	0	D=A	Transfer
1	0	1	0	D=A+1	Increment
1	1	0	1	D=A-1+0=A-1	Decrement
1	1	1	1	D=A-1+1=A	Transfer

3.4. PIN DIAGRAM:

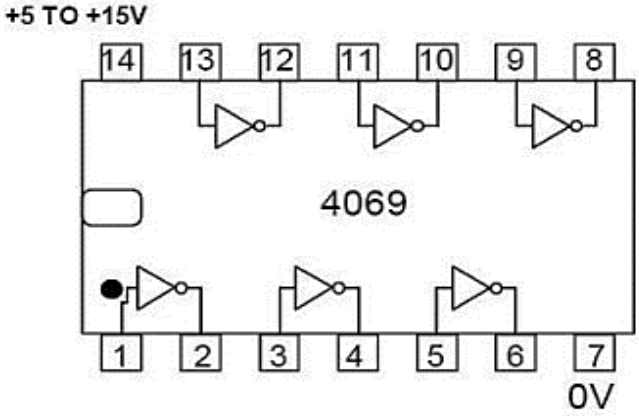
IC 4008:



IC 4539:



IC 4069:



3.5. PROCEDURE:

I. Place the breadboard gently on the observation table.
II. Fix the IC which is under observation between the half shadow line of breadboard, so there is no shortage of voltage.
III. Connect the wire to the main voltage source (V_{DD}) whose other end is connected to last pin of the IC (marked as V_{DD}).
IV. Connect the ground of IC (marked as GND) to the ground terminal provided on the digital lab kit.

V. Connect the input pins of ICs to the input switches on digital lab kit by using connecting wires.
VI. Connect output pins to the led on digital lab kit.
VII. Switch on the power supply.
VIII. If LED glows red then output is true (logic 1), if it glows green output is false (logic 0).

3.6. RESULT:

A 4-bit Arithmetic Circuit was designed and its truth table was verified.

3.7. PRECAUTIONS:

- All connections should be made neat and tight.
- Digital lab kits and ICs should be handled with utmost care.
- While making connections main voltage should be kept switched off.
- Never touch live and naked wires.

3.8. CONCLUSION: