FR. Conceicao Rodrigues College of Engineering
Department of Computer Engineering

3. Design and Realization of Logic Function using Multiplexer 74151 / Decoder 74138.

1. Course, Subject & Experiment Details

Academic Year	2023-24	Estimated Time	Experiment No. 3– 02 Hours
Course & Semester	S.E. (Computers) – Sem. III	Subject Name	Digital Logic & Computer Organization and Architecture
Chapter No.	3	Chapter Title	Processor Organization and Architecture
Experiment Type	Hardware	Subject Code	CSC304

Rubrics

Roll No.	Date of performance	Timeline (2)	Practical Skill & Applied Knowledge (4)	Output (4)	Total (10)
9914	Date of Submission				

2. Aim & Objective of Experiment

☐ To learn about various applications of multiplexer and Decoder
☐ To learn and understand the working of IC 74151 and IC 74138
☐ To learn to realize any function using Multiplexer and decoder

3. Problem Statement

A) Design and implement the following functions:

    1) Using IC 74151: $F(A,B,CD) = \sum m\ (0,2,4,7,8,9,12,13,14)$

B) Implement 3:8 Decoder using 2:4 Decoder.


4. Hardware Required

    A) Breadboard , Power Supply, Connecting wires.
    B) Components: IC 74151/IC 74138,LEDs

5. Brief Theoretical Description

Multiplexing means transmitting a large number of information units over a smaller number of channels or lines. A digital multiplexer is a combinational circuit that selects binary information from one of the many inputs lines and directs it to a single output line. The selection of a particular input line is controlled by a set of selection lines. Normally, there are 2^n input lines and n selection lines whose bit combinations determine which input is selected.
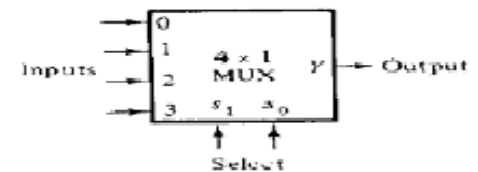
    Multiplexers are very useful components in digital systems. They transfer a large number of information units over a smaller number of channels, (usually one channel) under the control   of selection signals. Multiplexer means many to one. A multiplexer is a circuit with many inputs but only one output. By using control signals (select lines) we can select any input to the output. Multiplexer is also called as data selector because the output bit depends on the input data bit that is selected. The general multiplexer circuit has 2^n input signals, n control/select signals and 1 output signal.

(a) Logic diagram
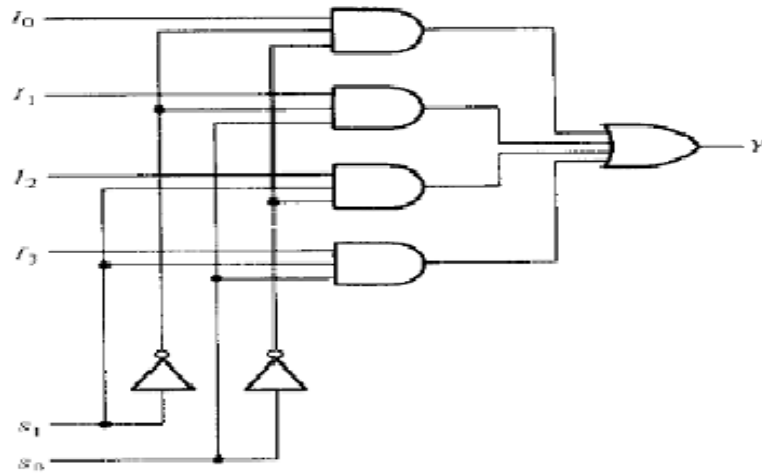
A 4-to-1-line multiplexer

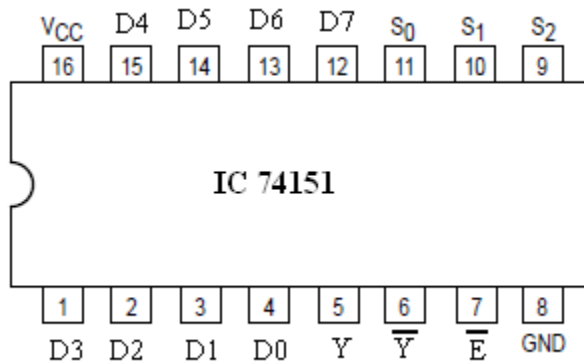| s_1	s_0	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

(b) Function table

(c) Block diagram

IC 74151

Input pins: 1 – 4 (D3-D0), 12- 15 (D4-D7)
Output pins: 5 (active high output / Y) , 6 (Active low output / $\overline{Y}$)
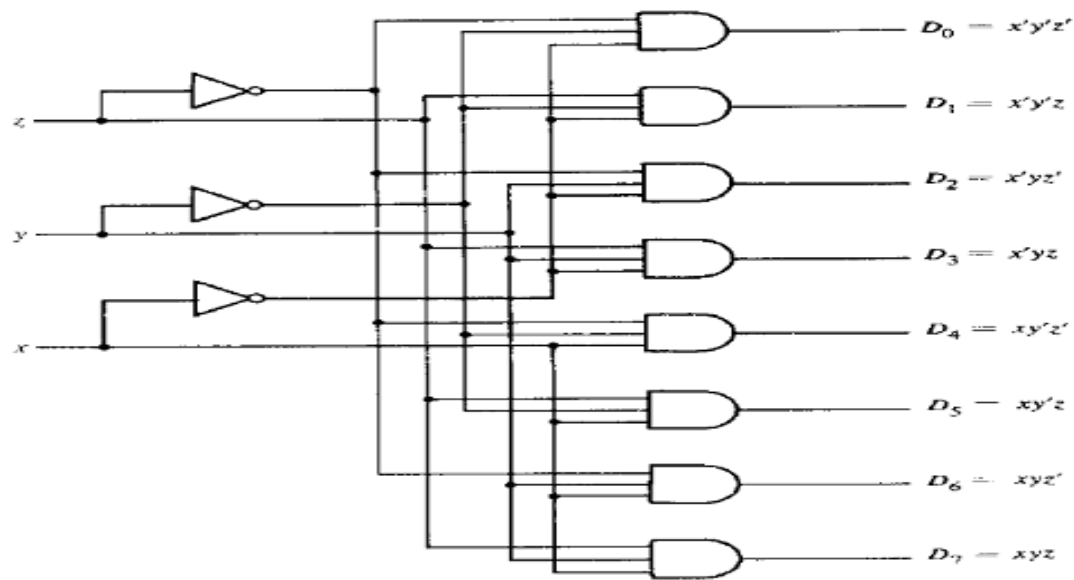**Select lines: 9-11 (S2 – S0)**

Enable signal: 7 ($\overline{E}$)
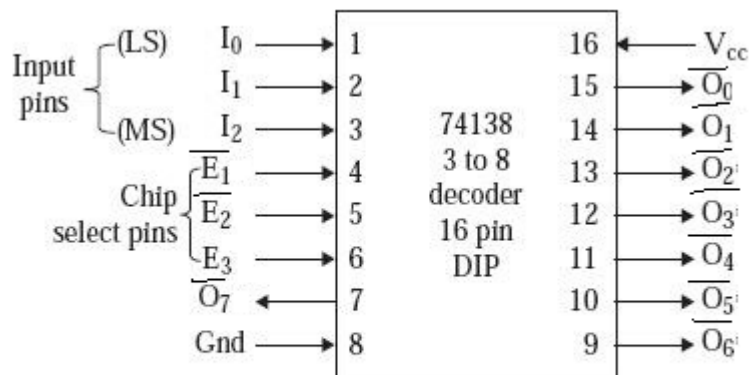**Supply: VCC: 16**
GND: 8

Note: Attach separate page for design steps and circuit diagram for the given problem
        statement.

Decoder: A decoder is a combinational circuit that converts binary information from n imputs lines to a maximum of 2n unique output lines.

A 3-to-8 line decoder

Consider the above figure **3 to 8 line decoder** . The three inputs are decoded into eight outputs, each output representing one of the minterms of the 3 inputs variables. The three inverters provide the complement of the inputs, and each one of the eight AND gates generates one of the minterms. A particular application of this decoder would be a binary to octal conversion.

3 : 8 decoder IC 74138

Select lines: 1:3 (I0,I1,I2)
Output pins : 7 , 9 – 15 (O7 , O6- O15) Active low outputs.
Chip select pins: 4-5 (E1, E2 active low), 5 (E3: active high)
Supply Vcc : 16
Gnd: 8

Note: Attach separate page for design steps and circuit diagram for the given problem statement.

6. Procedure:

1) . Draw the truth table for the given design.

2). Make the connections according to the design circuit and verify the truth table.

3). Observe the results on LED

6. Conclusion:

Thus we have learned about various applications of the multiplexer and decoder. Also through this practical we have gained a hands on experience with IC 74151 and IC 74138. We the help of this IC we are able to develop most of the functions.

7. Post-lab:

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DLCOA: Lab 3 :- Postlab

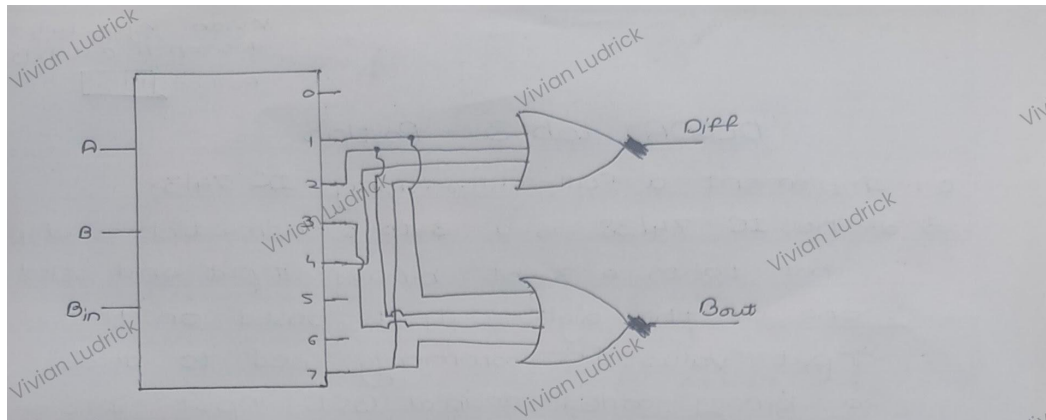Q.1. Implement a full-~~adder~~ subtractor using IC 74138.

⇒ a. The IC 74138 is a 3-to-8 demultiplexer chip that takes a 3-bit binary input and selects one of the eight outputs based on the input value. It's commonly used to decode a binary-coded decimal (BCD) input into an active-low output, where only one of the eight outputs is active at a time.

b. To implement a full ~~adder~~ subtractor using the IC 74138, you would need two of these. A full subtractor is a combinational circuit that performs a subtraction between two bits taking into account that one may have been borrowed by a lower significant stage

c. Implementation of full subtractor using 3-8 decoder.

Truth table.

Inputs					Diff minterms:
A	B	Bin	Bout	Diff	1,2,4,7
0	0	0	0	0	
0	0	1	1	1	Bout minterms:
0	1	0	1	1	1,2,3,7
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	

Q.2 Implement a Full adder using IC 74151

⟹ a. The IC 74151 is an 8-to-1 multiplexer chip used for data selection with three select inputs. They are used to determine which of the select inputs should be routed to the output.

b. A full adder is a combinational logic circuit that adds two data bits A and B and a carry-in bit C_{in} is called a Full

c. Truth table.

A	B	C	Carry	Sum
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

d. To get carry and sum we use two IC 74151