EXPERIMENT – 5

DIGITAL DISPLAY OF DEPARTMENT NAME

Aim: a) To Display a HEXA digit using 4:16 decoder circuit and 7 segment display.

b) To display department name "ECE" using HEX Digit Display and splitter in Logisim.

Components Required: 4 to 16 decoder, 7 segment display, Splitter, Hex Digit Display

Pre-lab:

1. **What is a splitter in Logisim?**

   In Logisim, a digital circuit design and simulation software, a "splitter" is a component used to manage bus wires—bundles of wires that carry multiple bits of information simultaneously. Splitters play a crucial role in organizing and manipulating the flow of multiple signals within a circuit, enabling a single bus to be divided into multiple subsets of wires or combining multiple inputs into a single bus. This functionality is essential for complex digital circuits, allowing for efficient data routing and processing.

2. **What is a HEX DIGIT Display in Logisim.**

   In Logisim, a "HEX Digital Display" (often simply referred to as a "Hex Display") is a component used to represent hexadecimal values visually. It's designed to display hexadecimal digits (0-9 and A-F) on the screen, which are the numerical representations for values 0 through 15 in base-16. Hexadecimal displays are commonly used in digital electronics and computer engineering for compactly displaying binary data, as each hex digit corresponds to four bits (or a nibble) of binary information.

3. **What is a 7-segment Display in Logisim.**

   In Logisim, a "7-Segment Display" is a component used to visually represent decimal numbers (0-9) and, in some configurations, a limited set of alphabetic characters (A-F, for hexadecimal values). This component simulates the behavior of real-world seven-segment displays, which are widely used in digital clocks, calculators, and other electronic devices to show numerical information.

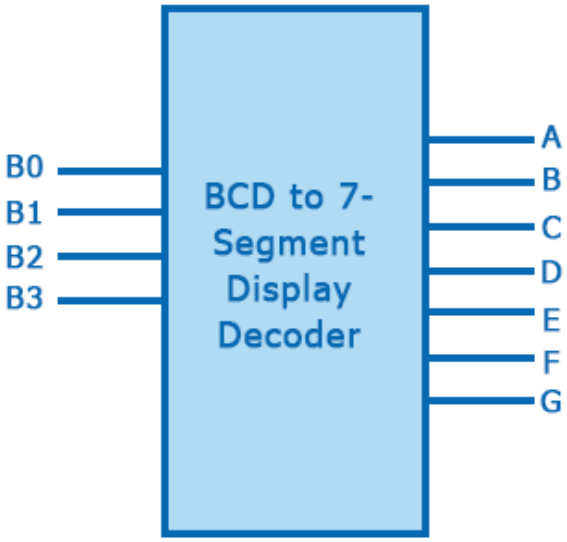
4. How the 4:16 decoder works?

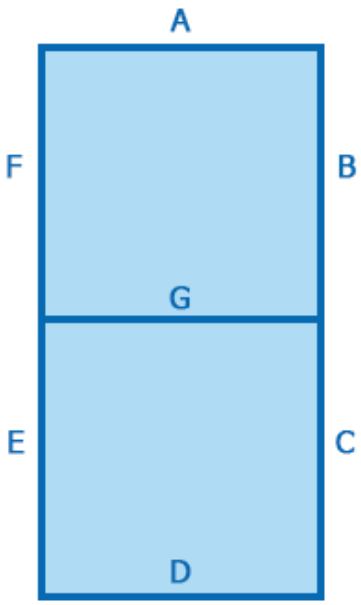
A 4:16 decoder is a digital logic component that decodes a 4-bit binary input into one of 16 outputs, with each output corresponding to one of the possible combinations of the 4-bit input. Essentially, it converts a binary value into a one-hot encoded output, where only one of the 16 outputs is active (high) at any time, based on the 4-bit input value.

Theory:

Seven segment decoder:

The seven-segment decoder, which has four input lines and seven output lines (a, b, c, d, e, f, and g), receives this BCD (A, B, C, and D) input. The output is provided to a seven-segment LED display that shows the decimal number depending on the inputs.



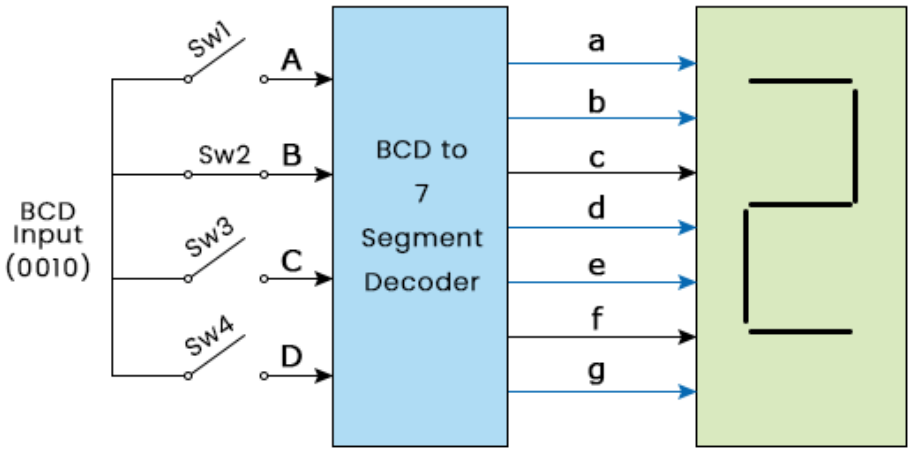


The truth table of **4-bit binary (Hex decimal) to 7 segment display** is given below:

Decimal Number	INPUT Lines				OUTPUT Lines						
	A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	0
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	0	1	1
A (10)	1	0	1	0	1	1	1	0	1	1	1
B (11)	1	0	1	1	1	1	1	1	1	1	1
C (12)	1	1	0	0	1	0	0	1	1	1	0
D (13)	1	1	0	1	1	1	1	1	1	1	0
E (14)	1	1	1	0	1	0	0	1	1	1	1
F (15)	1	1	1	1	1	0	0	0	1	1	1

For Example to display, Decimal Number = 2

The input lines for two are A = 0, B = 0, C = 1, and D = 0; in the output lines, a, b, d, e, and g are 1 and c and f are zero. So, only a, b, d, e, and g will glow, and we get two on display.



So, output equations from truth table can be written as follows.

$$a = \sum m(0, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15)$$

$$b = \sum m(0, 1, 2, 3, 4, 7, 8, 9, 10, 11, 13)$$

$$c = \sum m(0, 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13)$$

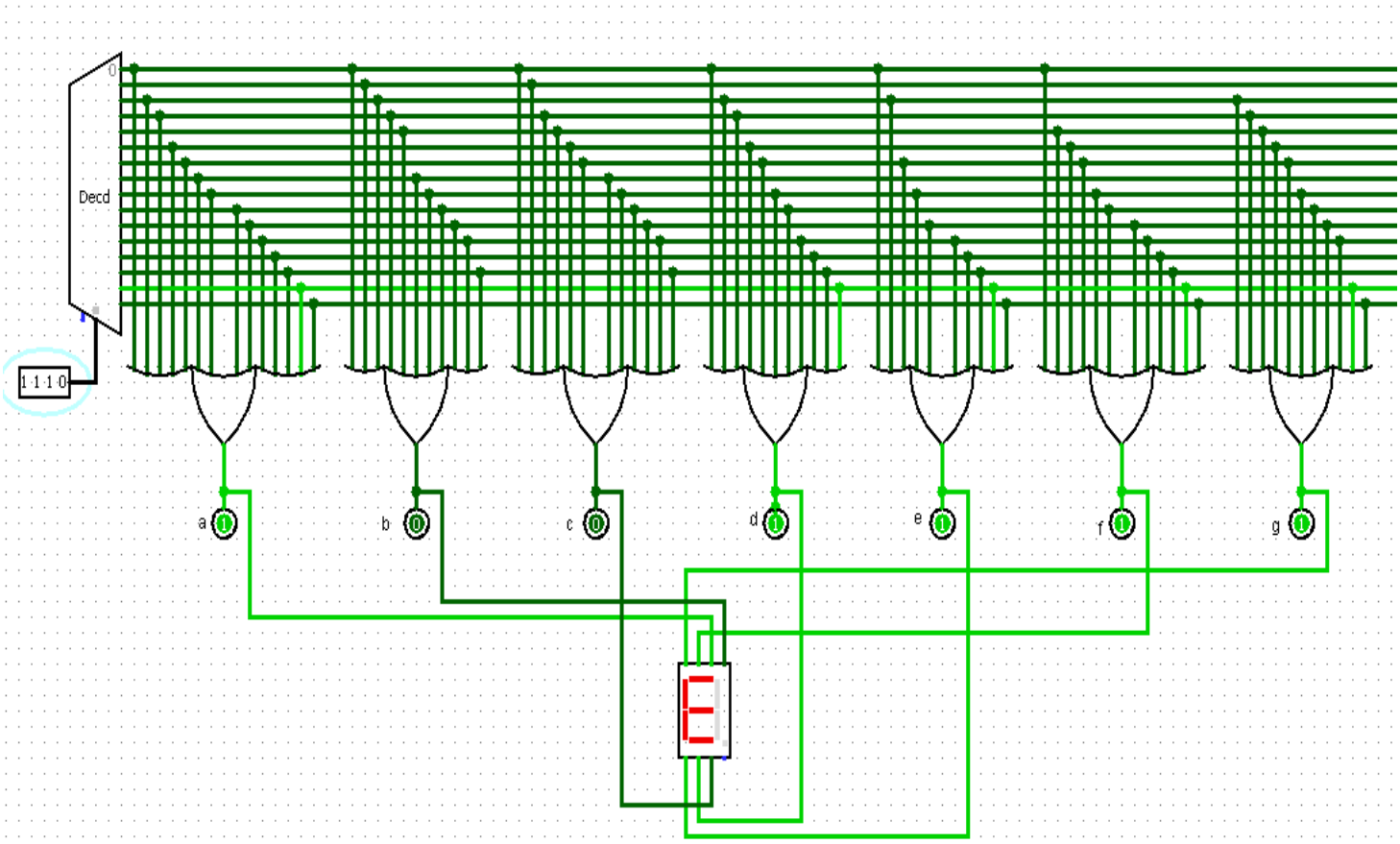
$$d = \sum m(0, 2, 3, 5, 6, 8, 9, 11, 12, 13, 14)$$

$$e = \sum m(0, 2, 6, 8, 10, 11, 12, 13, 14, 15)$$

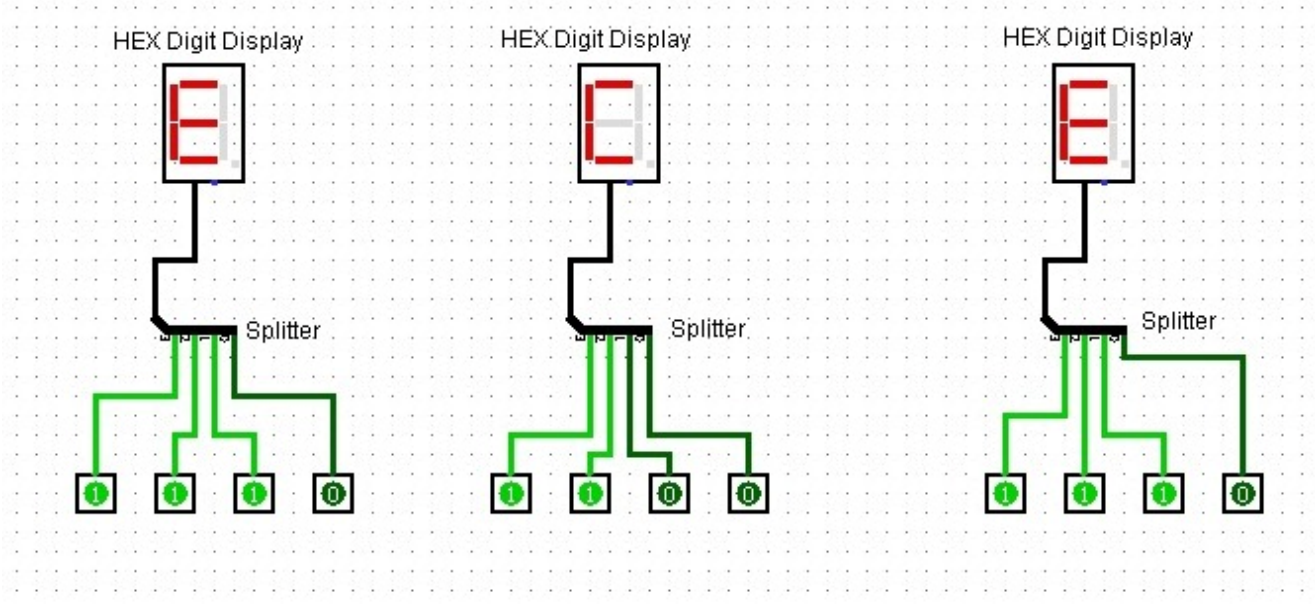
$$f = \sum m(0, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15)$$

$$g = \sum m(2, 3, 4, 5, 6, 8, 9, 10, 11, 14, 15)$$

Circuit Diagram: (a) Display a HEXA digit using 4:16 decoder circuit and 7 segment display



(b) Display department name "ECE" using HEX Digit Display and splitter:



Procedure:

1. Collect the 4:16 decoder, required number OR gates, 7 segment display and connect as shown in Fig (a).
2. Vary the input 4 digits and observe the digits of "0" to "9" and "A, B, C, D, E, F" based on input selection.
3. Collect the required number of splitters & HEX digit displays and connect as shown in Fig (b).
4. Vary the input 4 digits in each case as "1110" , "1100", "1110" to observe the output as "ECE".

Viva Questions and answers:

1. **Specify the applications of decoder.**
2. **What is the difference between 7 segment display and Hexa display?**
3. **How the multiple numbers can be displayed using decoder circuit?**

Result: Student is able to design a display circuit using decoders and splitters.