Name: Bandaru Sri Naga Akhil

Roll Number: 20EE10085

Experiment – 3

Lab Report

Part – A:

Aim: Verification of Truth Table of IC74157

Components Used:

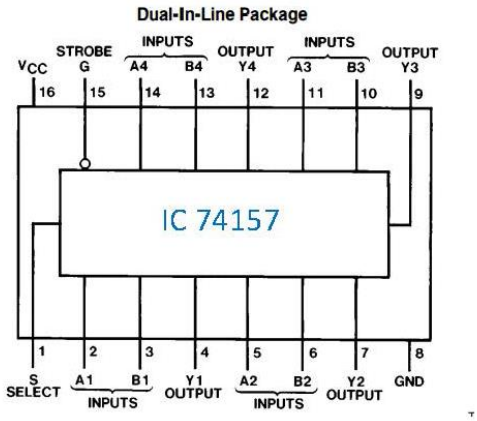
1. Voltage source – 5V (External Power supply)
2. Resistor – 330Ω

   The voltage drop across LED is 1.7V. For 10mA current to flow through the resistor, its resistance should be (5-1.7)V/10mA = 330Ω
3. Resistor - 1000Ω (Pull-up Resistance)
4. Common Anode 7 segment LED display (Red) (To display the output digits)
5. IC74157:74LS157 – Quad 2-input multiplexer with common select
6. Logic switch (To select the input either 1 (high) or 0 (low))
7. Connecting wires

Theory:

IC74157:

Part A

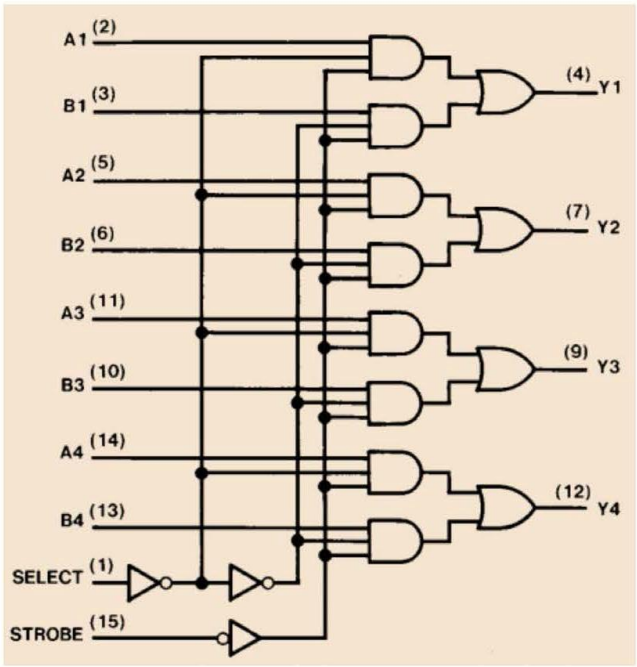


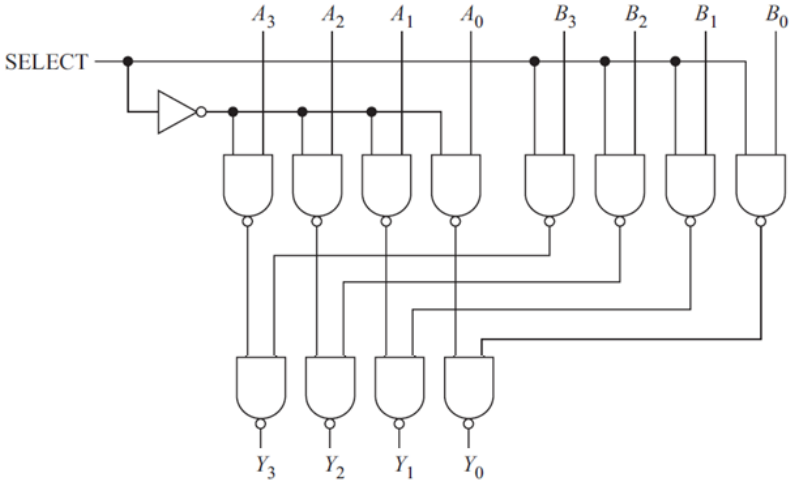
Inputs				Output Y
Strobe	Select	A	B	
H	X	X	X	L
L	L	L	X	L
L	L	H	X	H
L	H	X	L	L
L	H	X	H	H

H = High Level, L = Low Level, X = Don't Care

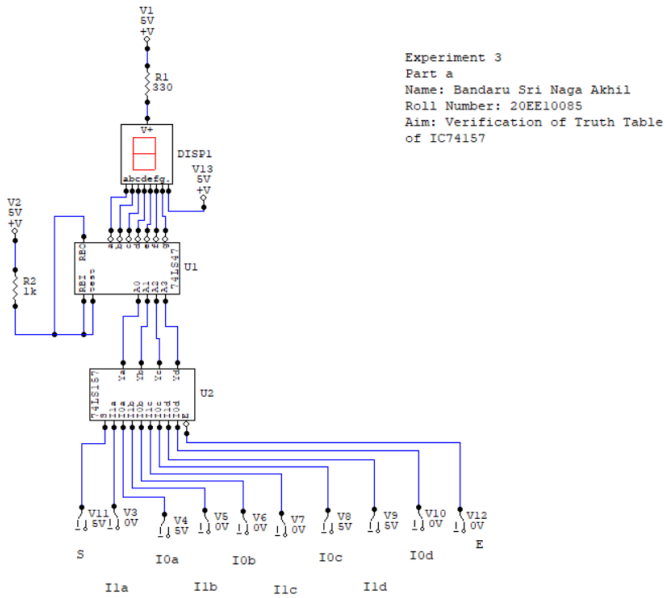
- IC 74157 is a quad 2-input multiplexer with common select

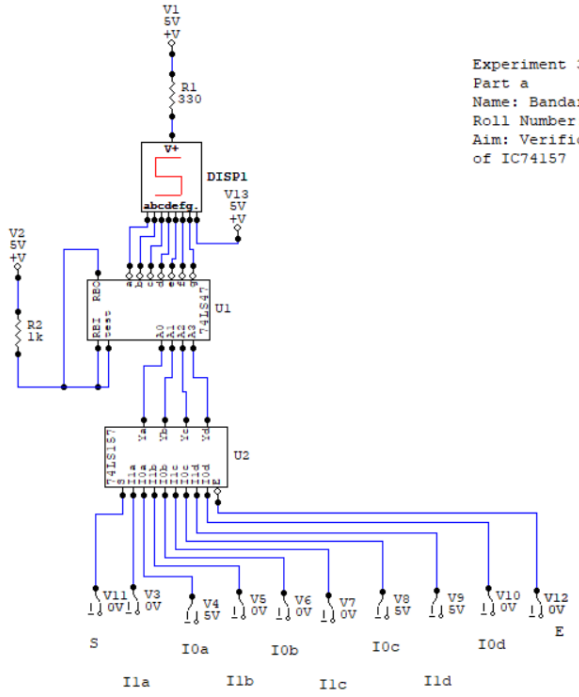
IC74157 is a quad 2-input multiplexer with common select. There are 2 sets of 4 input pins and 4 output pins with a select pin and strobe pin (active low). Based on the strobe pin and select pin, the output is generated. From the Truth Table of IC74157, we can see that when the strobe is high, regardless of the select pin the output is set to low. When the strobe is low and select pin is also low, the output generated is same as the input given to the input A pins. And when the strobe is low and select pin is at high, the output generated is same as the given input to B pins. Since there is a common select for all the pins , the 4 output pins values are same as either A or B pins with the same select pin.





Circuit Diagram:





Experiment 3
Part a
Name: Bandaru Sri Naga Akhil
Roll Number: 20EE10085
Aim: Verification of Truth Table of IC74157

Discussion/Results:

From the simulation we can observe that, when the strobe is low and when the select is high, all the I1 pins gets selected and they are given as the outputs of the IC74157. Since I1d, I1c, I1b, I1a are 1, 0, 0, 0 respectively, the output displayed is 8

Also we can observe that, when the strobe is low and when the select is low, all the I0 pins gets selected and they are given as the outputs of the IC74157. Since I0d, I0c, I0b, I0a are 0, 1, 0, 1 respectively, the output displayed is 5

Part – B:

Aim: Displaying my Roll Number (20EE1085) or Friend's Roll Number (20EE1050) in the same 7 segment display at different point of time

Components Used:

1. Voltage source – 5V (External Power supply)
2. Resistor – 330Ω

   The voltage drop across LED is 1.7V. For 10mA current to flow through the resistor, its resistance should be (5-1.7)V/10mA = 330Ω
3. Resistor - 1000Ω (Pull-up resistance)
4. Common Anode 7 segment LED display (Red) (To display the output digits)
5. IC7447:74LS47 – BCD to 7 segment converter
6. 2 IC74138:74LS138 – 3-to-8-line decoder integrated circuit
7. IC7493:74LS93 – Modulo 2 and Modulo 8 counter (acts as a frequency divider and counter)
8. IC74157:74LS157 – Quad 2-input multiplexer with common select
9. NAND gates – (IC7400 (2 input), IC7410 (3 input) and IC7420 (4 input))
10. NOT gate – IC7404
11. Digital Pulser – provides the input pulse
12. Logic switch (To select the input either 1 (high) or 0 (low))
13. Connecting wires
14. Ground

Theory:

IC74157 – Quad 2-input multiplexer with common select is used to display two different Roll Numbers in the same CA 7 segment display at different point of time. IC74138 which is a 3-to-8 decoder and IC7493 which can be used as modulo 8 counter is used to generate My Roll Number – 20EE1085 and My Friend's Roll Number – 20EE1050 using a digital pulser.

Output pins of IC74138	Roll Number	A3	A2	A1	A0	'a' pin of the display due to correction circuit
Q0	2	0	0	1	0	1
Q1	0	0	0	0	0	1
Q2	E	1	1	1	0	0

Q3	E	1	1	1	0	0
Q4	1	0	0	0	1	1
Q5	0	0	0	0	0	1
Q6	8	1	0	0	0	1
Q7	5	0	1	0	1	1

Hence, to get the Roll Number 20EE1085,

A3 = ∑m(2, 3, 6)

A2 = ∑m(2, 3, 7)

A1 = ∑m(0, 2, 3)

A0 = ∑m(4, 7)

So we connect the NAND gates appropriately to get the desired Roll Number.

Output pins of IC74138	Roll Number	A3	A2	A1	A0	'a' pin of the display due to correction circuit
Q0	2	0	0	1	0	1
Q1	0	0	0	0	0	1
Q2	E	1	1	1	0	0
Q3	E	1	1	1	0	0
Q4	1	0	0	0	1	1
Q5	0	0	0	0	0	1
Q6	5	0	1	0	1	1
Q7	0	0	0	0	0	1

Hence, to get the Roll Number 20EE1050,

A3 = ∑m(2, 3)

A2 = ∑m(2, 3, 6)

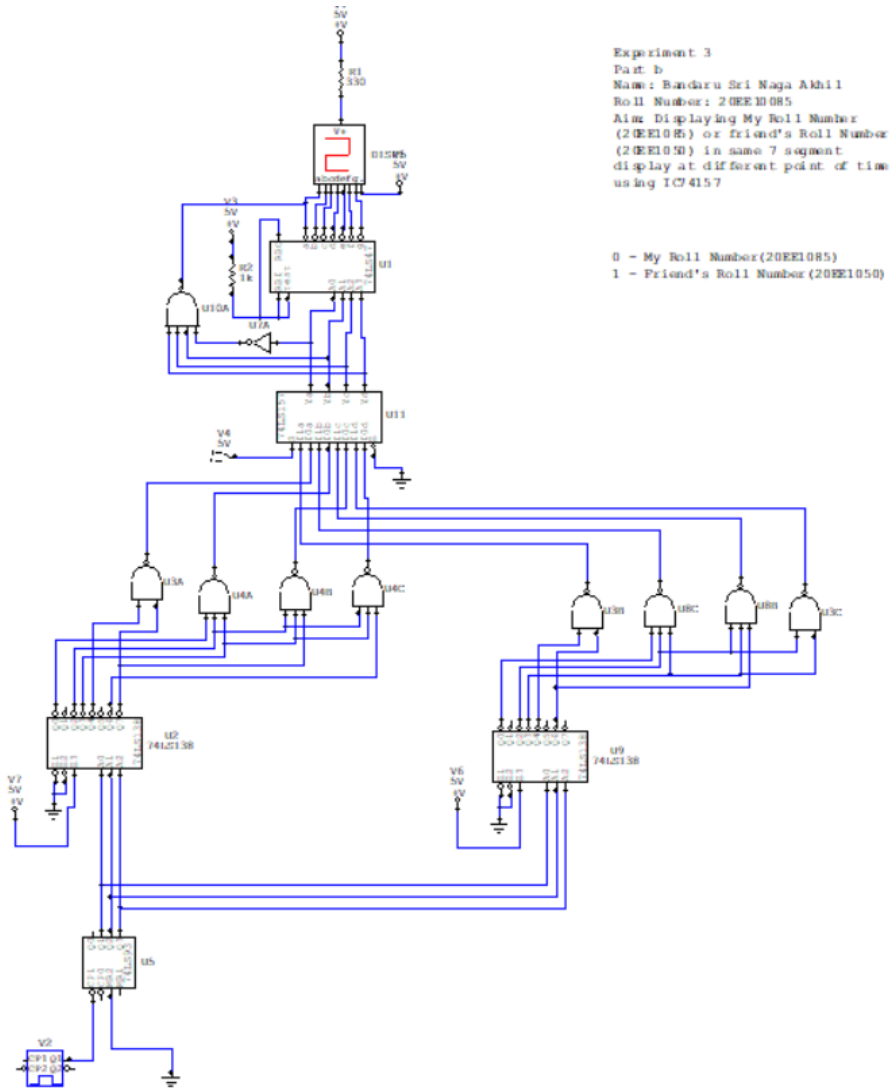
A1 = ∑m(0, 2, 3)

A0 = ∑m(4, 6)

So we connect the NAND gates appropriately to get the desired Roll Number.

Now the output of the NAND gates of the two circuits are connected to inputs of IC74157 such that when I0 pins are selected, My Roll Number is displayed and I1 pins are selected, My Friend's Roll Number is displayed. The strobe is always kept low, hence based on the common select pin, the output is displayed.

Circuit Diagram:



Discussion/Results:

From the simulation we can observe that, when the outputs of NAND gates which are connected to IC74138 are connected to inputs of IC74157 whose enable pin is low, when we keep the select pin is low, all the I0 pins of IC74157 gets selected and we get them as output and hence My Roll Number – 20EE1085 gets displayed in the CA 7 segment display. When the select pin is high, keeping the enable pin low, all the I1 pins of IC74157 gets selected and we get them as output and hence My Friend's Roll Number – 20EE1050 which can be seen through the same display.

Part – C:

Aim: Verification of Truth Table of IC74151

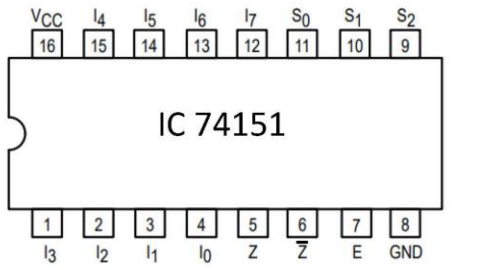
Components Used:

1. IC74151:74LS151 – 8 to 1 MUX with both inverted and non-inverted output
2. LED (Red)
3. Logic switches (To select the input either 1 (high) or 0 (low))
4. Connecting wires
5. Ground

Theory:

IC74151:

Part C

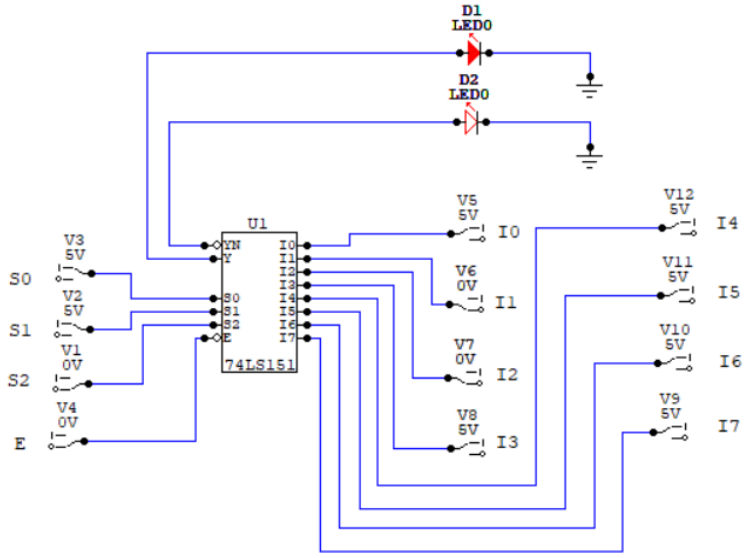


IC 74151: 8-to-1 MUX with both inverted and non-inverted output

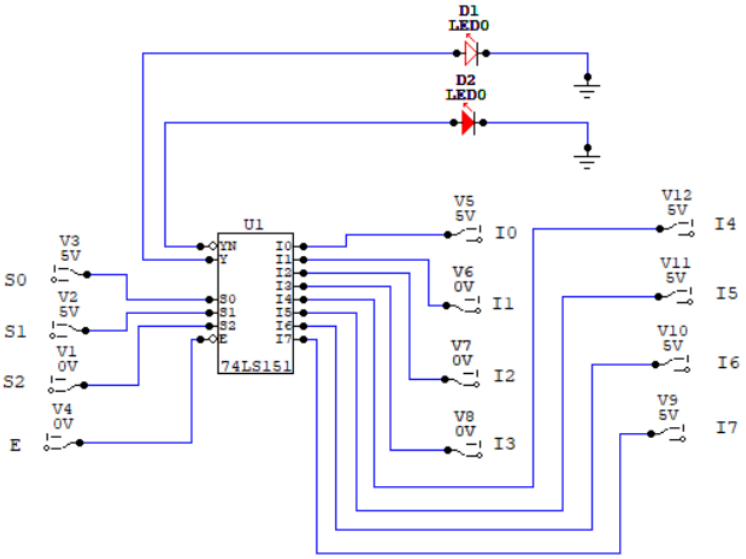
$\bar{E}$	S_2	S_1	S_0	I_0	I_1	I_2	I_3	I_4	I_5	I_6	I_7	$\bar{Z}$	Z
H	X	X	X	X	X	X	X	X	X	X	X	H	L
L	L	L	L	L	X	X	X	X	X	X	X	H	L
L	L	L	L	H	X	X	X	X	X	X	X	L	H
L	L	L	H	X	L	X	X	X	X	X	X	H	L
L	L	L	H	X	H	X	X	X	X	X	X	L	H
L	L	H	L	X	X	L	X	X	X	X	X	H	L
L	L	H	L	X	X	H	X	X	X	X	X	L	H
L	L	H	H	X	X	X	L	X	X	X	X	H	L
L	L	H	H	X	X	X	H	X	X	X	X	L	H
L	H	L	L	X	X	X	X	L	X	X	X	H	L
L	H	L	L	X	X	X	X	H	X	X	X	L	H
L	H	L	H	X	X	X	X	X	L	X	X	H	L
L	H	L	H	X	X	X	X	X	H	X	X	L	H
L	H	H	L	X	X	X	X	X	X	L	X	H	L
L	H	H	L	X	X	X	X	X	X	H	X	L	H
L	H	H	H	X	X	X	X	X	X	X	L	H	L
L	H	H	H	X	X	X	X	X	X	X	H	L	H

IC74151 is an 8-to-1 Multiplexer with both inverted and non-inverted output. It has 3 data select pins, 8 data input pins, 2 output pins which are inverse of each other and an enable pin (active low). From the Truth Table of IC74151, when the enable is high, the output Z is low and Z' is high, regardless of other data select pins and data input pins. When the enable is low, based on the value of the data select pins, the corresponding data input is selected and the output is same as that data input pin and z' is the inverse of that data input pin value.

Circuit Diagram:



Experiment 3
Part c
Name: Bandaru Sri Naga Akhil
Roll Number: 20EE10085
Aim: Verification of truth table of IC74151



Discussion/Results:

From the simulation we can observe that, when the enable pin is low, based on the S0, S1, S2 pins which are inputs to IC74151, we get the output such that Z is same as I pin corresponding to the given input pins and Z' is in opposite state of Z pin.

In the above circuit diagram, when enable is low, S2, S1, S0 pins are 0, 1, 1 respectively, I3 pin gets selected. When the I3 pin is high, we get output from Y as high and Y' as low. Hence the LED connected to Y glows and other doesn't glow.

When enable pin is low, S2, S1, S0 pins are 0, 1, 1 respectively, I3 pin gets selected. When the I3 pin is low, we get the output from Y as low and Y' as high. Hence the LED connected to Y' glows and the other doesn't glow.

Part – D:

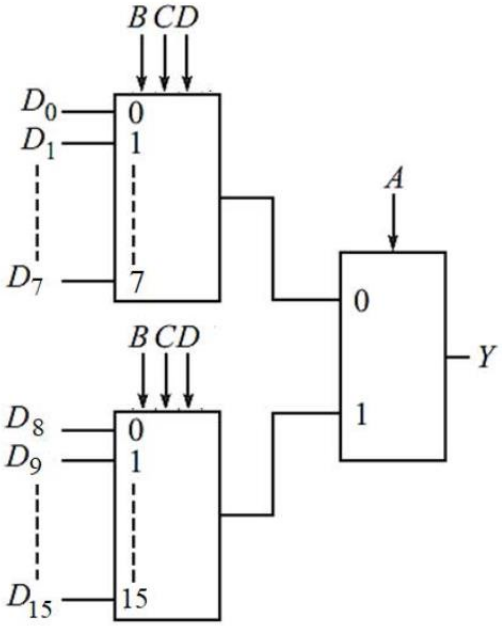
Aim: Constructing Higher order MUX (16 to 1) from Lower order MUX (IC74151 and IC74157)

Components Used:

1. 2 IC74151:74LS151 – 8 to 1 Multiplexer with both inverted and non-inverted outputs.
2. IC74157:74LS157 – Quad 2-input multiplexer with common select
3. Voltage source – 5V (External Power Supply)
4. LED (Red)
5. Connecting wires
6. Ground

Theory:

We can construct a 16-to-1 Multiplexer using 2 IC74151 (8-to-1 MUX) and 1 IC74157 (quad 2-input multiplexer with common select). So we connect 3 input pins out of the 4 input pins to both IC74151 as data select inputs and the remaining input pin (most significant) to data select of IC74157. The outputs of IC74151 are connected to IC74157 I0a pin and I1a pin and the other data input pins are kept high. The output of IC74157 is taken from Ya pin which is now equivalent to the output of 16-to-1 MUX and the data input pins of IC74151 are equivalent to the input pins of 16-to-1 MUX.

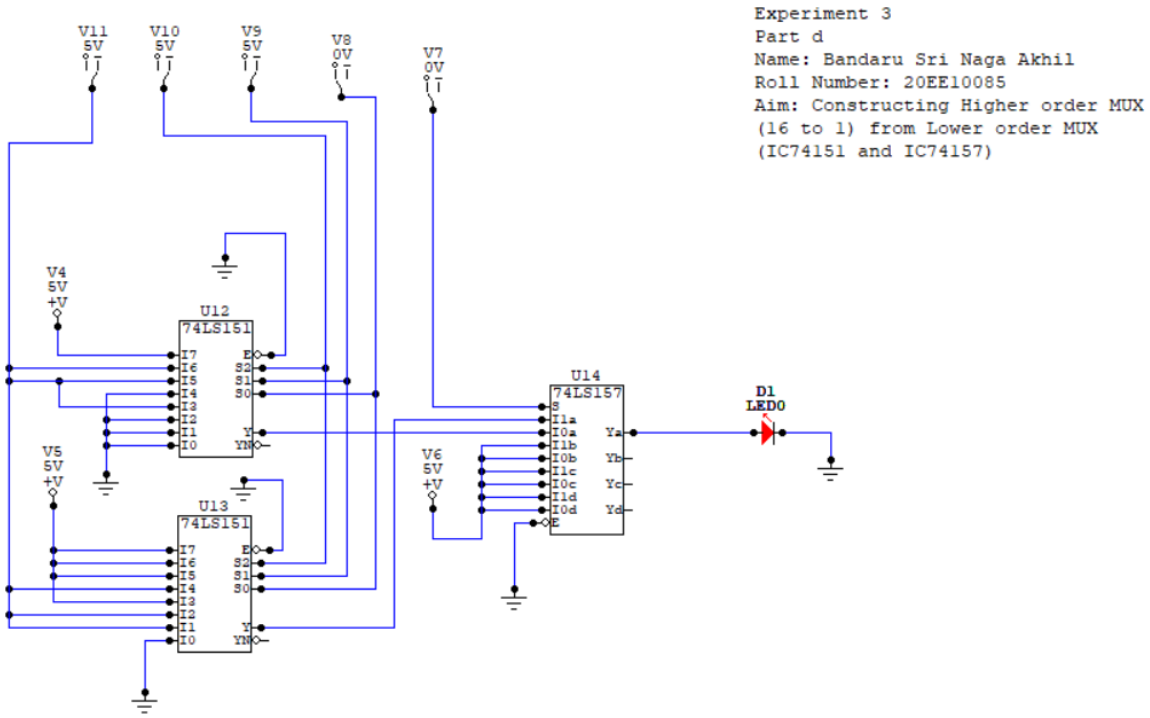


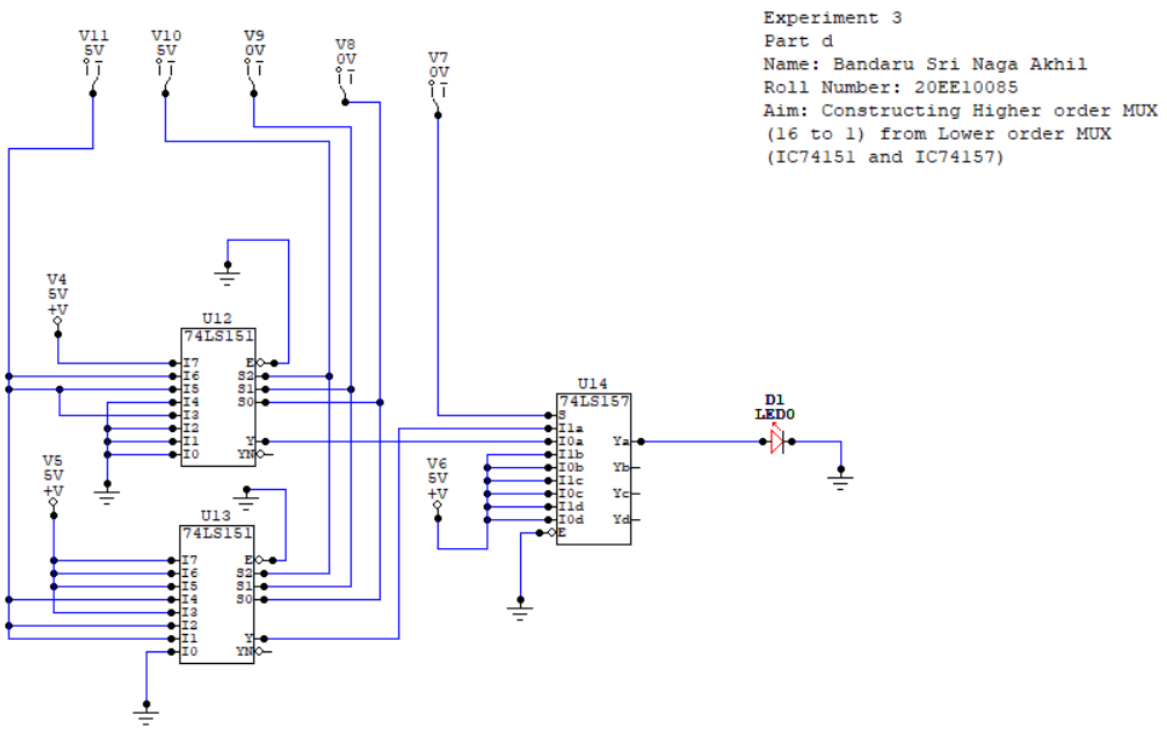
D_i pin	A	B	C	D
1	0	0	0	0
2	0	0	0	1
3	0	0	1	0
4	0	0	1	1
5	0	1	0	0
6	0	1	0	1
7	0	1	1	0
8	0	1	1	1
9	1	0	0	0
10	1	0	0	1
11	1	0	1	0
12	1	0	1	1

13	1	1	0	0
14	1	1	0	1
15	1	1	1	0
16	1	1	1	1

The complete Truth Table corresponds to 16-to-1 MUX in which the first 8 rows correspond to one IC74151 and last 8 rows corresponds to another IC74151 which are combined using IC74157. Since the only difference between the first 8 and last 8 rows are A column, the B, C and D are given as data select pins of IC74151 and A is given as data select pin of IC74157.

Circuit Diagram:





Discussion/Results:

In the above circuit diagram, 3 switches are connected to 2 IC74151 in common and the output of those two IC74151 are connected to I0a, I1a of IC74157 whose enable is low and the strobe is connected to another logic switch. At the output of IC74157 a LED is connected and the other input pins are connected as logic high. Since 16-to-1 multiplexer has 4 input pins, we can consider these 4 logic switches as their input pins. The most significant bit is connected to IC74157.

The above circuit is designed such that we get high output when most of the switches are at high logic level and output low when most of the switches are at low logic level. Accordingly I0 to I7 of both the IC74151 are connected to either logic switch or at high or at low.

Part – E:

Aim: Majority voting-based display of My Roll Number (20EE1050) or my Friend's Roll Number (20EE1050) using IC74151 and IC74157

Components Used:

1. Voltage source – 5V (External Power supply)
2. Resistor – 330Ω

   The voltage drop across LED is 1.7V. For 10mA current to flow through the resistor, its resistance should be (5-1.7)V/10mA = 330Ω
3. Resistor - 1000Ω (Pull-up resistance)
4. Common Anode 7 segment LED display (Red)
5. IC7447:74LS47 – BCD to 7 segment converter
6. 2 IC74138:74LS138 – 3-to-8-line decoder integrated circuit
7. IC7493:74LS93 – Modulo 2 and Modulo 8 counter (acts as a frequency divider and counter)
8. IC74157:74LS157 – Quad 2-input multiplexer with common select
9. 2 IC74151:74LS151 – 8 to 1 Multiplexer with both inverted and non-inverted outputs
10. NAND gates – (IC7400 (2 input), IC7410 (3 input) and IC7420 (4 input))
11. NOT gate – IC7404
12. Digital Pulser – provides the input pulse
13. Logic switch (To select input either 1 (high) or 0 (low))
14. Connecting wires
15. Ground

Theory:

For the majority-based voting display of Roll Numbers, we first convert the 5 data inputs to 4 data inputs and implement this 4 data inputs using 2 IC74151 (8-to-1 MUX) and 1 IC74157 (Quad 2-input multiplexer with a common select).

S.No.	E	D	C	B	A	Y	Y
1 2	0 0	0 0	0 0	0 0	0 1	0 0	0
3 4	0 0	0 0	0 0	1 1	0 1	0 0	0
5	0	0	1	0	0	0	0

6	0	0	1	0	1	0	
7 8	0 0	0 0	1 1	1 1	0 1	0 1	A
9 10	0 0	1 1	0 0	0 0	0 1	0 0	0
11 12	0 0	1 1	0 0	1 1	0 1	0 1	A
13 14	0 0	1 1	1 1	0 0	0 1	0 1	A
15 16	0 0	1 1	1 1	1 1	0 1	1 1	1
17 18	1 1	0 0	0 0	0 0	0 1	0 0	0
19 20	1 1	0 0	0 0	1 1	0 1	0 1	A
21 22	1 1	0 0	1 1	0 0	0 1	0 1	A
23 24	1 1	0 0	1 1	1 1	0 1	1 1	1
25 26	1 1	1 1	0 0	0 0	0 1	0 1	A
27 28	1 1	1 1	0 0	1 1	0 1	1 1	1
29 30	1 1	1 1	1 1	0 0	0 1	1 1	1
31 32	1 1	1 1	1 1	1 1	0 1	1 1	1

From this table we can see that the output Y can be expressed in terms of A (which is the least significant select input). So now we construct 16 to 1 MUX from the select inputs B, C, D, E using 1 IC74157 and 2 IC74151.

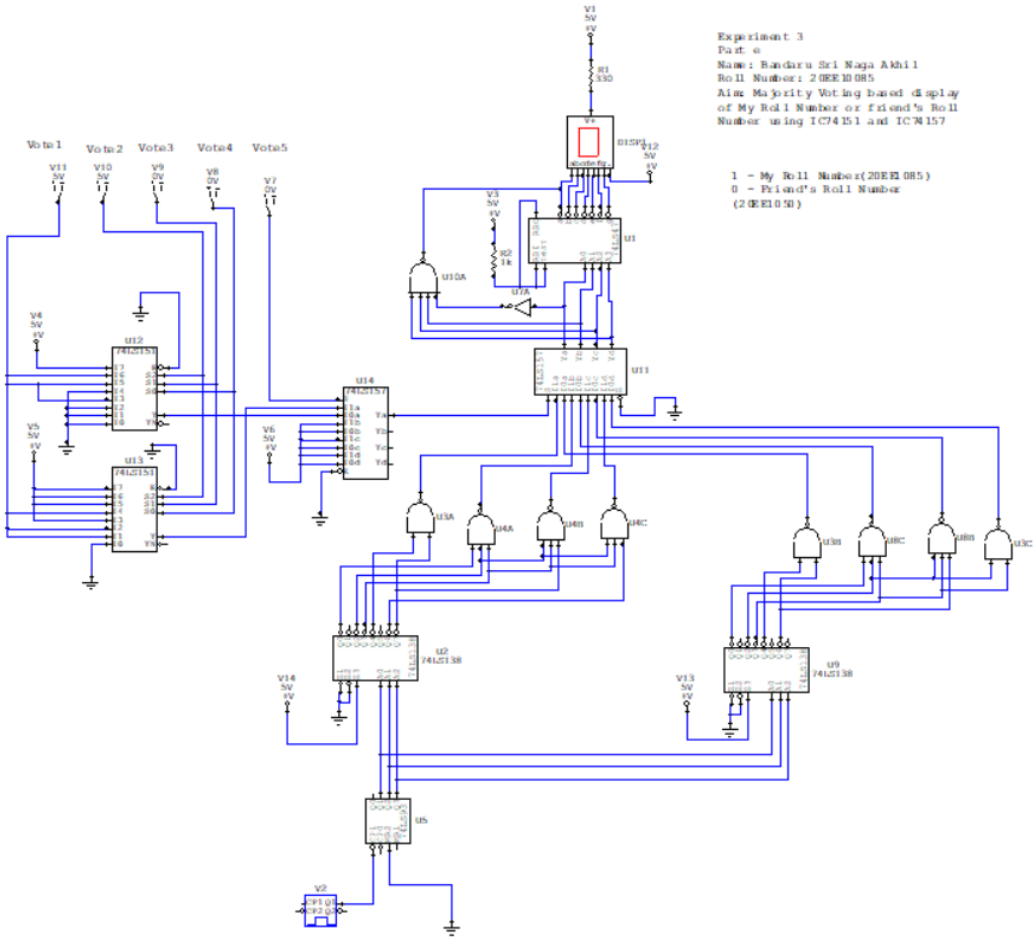
D_i pin	E	D	C	B	Y
0	0	0	0	0	0
1	0	0	0	1	0
2	0	0	1	0	0
3	0	0	1	1	A
4	0	1	0	0	0
5	0	1	0	1	A
6	0	1	1	0	A
7	0	1	1	1	1
8	1	0	0	0	0
9	1	0	0	1	A
10	1	0	1	0	A
11	1	0	1	1	1
12	1	1	0	0	A
13	1	1	0	1	1

14 15	1 1	1 1	1 1	0 1	1 1

Hence, we can construct the circuit accordingly to get the output based on the majority of inputs.

Now connect this output to the select pin of another IC74157 whose data input pins are connected to the NAND gates of the circuits which can display My Roll Number (20EE1085) and My Friend's Roll Number (20EE1050) which are made using IC74138 and IC7493. The enable pin of that IC74157 is at low. We connect them such that when the majority of votes are 1, the enable pin of IC74157 is 1 and My Roll Number is displayed (since I1 pins are connected to the circuit that generates 20EE1085) and when the majority of votes are 0, the enable pin of IC74157 is 0 and My Friend's Roll Number is displayed on the same CA 7 segment display (since I0 pins are connected to the circuit that generates 20EE1050)

Circuit Diagram:



Discussion/Results:

From the above table we can convert 5 inputs input to 4 inputs and connect other voting pin to IC74151 select pins. From the simulation we can observe that when most of the votes are 1 (high) My Roll Number – 20EE1085 gets displayed on the same CA 7 segment and when most of the votes are 0 (low) My friend's Roll Number – 20EE1050 gets displayed on the same CA 7 segment display

Simulation Links:

Part – A:

https://drive.google.com/file/d/1EucnPkyf9HEMoMMfFWNSz5lExAZf7FEw/view?usp=sharing

Part – B:

https://drive.google.com/file/d/1lN3SCx9MzgjHxq1m4lDJcImb-KAoqq6q/view?usp=sharing

Part – C:

https://drive.google.com/file/d/1JvHbNpuIZCHtiS-GuHCkWmGFZqXJVvoQ/view?usp=sharing

Part – D:

https://drive.google.com/file/d/1sBPYaxCPiIRHlzpR_lzWNVIU0-LLZ_C1/view?usp=sharing

Part – E:

https://drive.google.com/file/d/1vYjhD8r8U5VHwbLzXttN3Y79iI6ldp9C/view?usp=sharing