NAME : Malla Sailesh
ROLL NUMBER : 2021101106
GROUP NUMBER: 6

<div align="center">

LAB 3
DIGITAL SYSTEMS AND MICROCONTROLLLERS

</div>

AIM:
1) **Part A :** To design , assemble and test a multiplexer(4:1) also called as mux
2) **Part B :** To design , assemble and test a De-mutiplexer (1:4) also called as demux
3) **Part C :** Combine Multiplexer and De-Multiplexer

Theory:
1) **MULTIPLEXER :**
    A multiplexer (or mux) is a device that selects one of several analog or digital input signals and forwards the selected input into a single line. A multiplexer with 2^n inputs has n select lines which are used to select which input line to send to the output .

2) **DE- MULTIPLEXER:**
    A demultiplexer (or demux) is a device taking a single input signal and selecting one of many data-output-lines, which is connected to the single input. A multiplexer is often used with a complementary demultiplexer on the receiving end.

ELECTRONIC COMPONENTS:
1) **Arduino**
2) **Led**
3) **Resistor**
4) **Breadboard**
5) **Integrated Circuits(OR gate , 3 input And gate , Not gate)**

REFERENCE CIRCUITS :
1) **Part A :** https://crcit.net/c/435c6dc135fa4a76a432111fdb71de91
2) **Part B :** https://crcit.net/c/6467d30c15ff41eb9001743fd80040d5
3) **Part C :** https://crcit.net/c/5db1b84c69f34173b111258cb0c12ce9

PROCEDURE:

1) **Part A:**

    1) A 4 to 1 multiplexer consists of two select lines(S0 and S1) and 4 data input   lines(I0 to I3) and also a single output line(Y).The select lines select one of the input line(D0 to D3) to connect to the output line.
    2) As there are 2 select lines . The combination of them gives 00, 01,10,11.These are used to select the inputs (I0 to I3). That means that when S0 and S1 =0 input I0 gives the output etc .Therefore Y = I0(S1)'(S0)'

when S1 and S0 = 0.Similarly I1 to I3 . Thus finally Y = I0(S1)'(S0)' + I1(S1)'(S0)+I2(S1)(S0)'+I3(S1)(S0).This is possible iff our connections are made relevant to it . They may vary also.

3)CODE:

```
int S1,S2,I0,I1,I2,I3;
void setup()
{
  pinMode(7,OUTPUT);
  pinMode(6,OUTPUT);
  pinMode(5,OUTPUT);
  pinMode(4,OUTPUT);
  pinMode(3,OUTPUT);
  pinMode(2,OUTPUT);
  Serial.begin(9600);//sets the data rate to 9600 bps

}

void loop()
{
  Serial.print("S1=");
  while(Serial.available()==0){}
  S1 = Serial.read();
  S1=S1-'0';
  Serial.println(S1);

  Serial.print("S2=");
  while(Serial.available()==0){}
  S2 = Serial.read();
  S2=S2-'0';
  Serial.println(S2);

  Serial.print("I0=");
  while(Serial.available()==0){}
  I0 = Serial.read();
  I0=I0-'0';
  Serial.println(I0);

  Serial.print("I1=");
  while(Serial.available()==0){}
  I1 = Serial.read();
  I1=I1-'0';
  Serial.println(I1);
```

```
        Serial.print("I2=");
        while(Serial.available()==0){}
        I2 = Serial.read();
        I2=I2-'0';
        Serial.println(I2);

        Serial.print("I3=");
        while(Serial.available()==0){}
        I3 = Serial.read();
        I3=I3-'0';
        Serial.println(I3);


        digitalWrite(2,S1);
        digitalWrite(3,S2);
        digitalWrite(4,I0);
        digitalWrite(5,I1);
        digitalWrite(6,I2);
        digitalWrite(7,I3);

        Serial.println("Enter the values again:");

        }
```

2) Part B :

1) A 1 to 4 De-multiplexer consists of two select lines(S0 and S1) , 1 data
input line(I) and 4 Output lines(y0 to y3) .
2) As there are two select lines which give combination such as
00,01,10,11.These specifically give output I for that specific combination .
Example: S0 and S1 = 00 implies that only y0 gives I as output and
remaining give 0 as output .This may or may not be based on our
connections. Similarly others
3)CODE:

```
 int S1,S2,I;
void setup()
{
  pinMode(4,OUTPUT);
  pinMode(3,OUTPUT);
  pinMode(2,OUTPUT);
  Serial.begin(9600);//sets the data rate to 9600 bps

}

void loop()
```

```
      {
        Serial.print("S1=");
        while(Serial.available()==0){}
        S1 = Serial.read();
        S1=S1-'0';
        Serial.println(S1);

        Serial.print("S2=");
        while(Serial.available()==0){}
        S2 = Serial.read();
        S2=S2-'0';
        Serial.println(S2);

        Serial.print("I=");
        while(Serial.available()==0){}
        I = Serial.read();
        I=I-'0';
        Serial.println(I);


        digitalWrite(2,S1);
        digitalWrite(3,S2);
        digitalWrite(4,I);

        Serial.println("Enter the values again:");

      }
```

3) **Part C :**

1) Connect Multiplexer and De- Multiplexer in a fashion such that output Y of the multiplexer will be connected as the input I to the demultiplexer to give the outputs (y0 to y3) . And also connect the common ground and vcc to both multiplexer and demultiplexer .
2)CODE:

```
 int S1,S2,I0,I1,I2,I3;
void setup()
{
  pinMode(7,OUTPUT);
  pinMode(6,OUTPUT);
  pinMode(5,OUTPUT);
  pinMode(4,OUTPUT);
  pinMode(3,OUTPUT);
  pinMode(2,OUTPUT);
  Serial.begin(9600);//sets the data rate to 9600 bps
```

```
}

void loop()
{
 Serial.print("S1=");
 while(Serial.available()==0){}
 S1 = Serial.read();
 S1=S1-'0';
 Serial.println(S1);

 Serial.print("S2=");
 while(Serial.available()==0){}
 S2 = Serial.read();
 S2=S2-'0';
 Serial.println(S2);

 Serial.print("I0=");
 while(Serial.available()==0){}
 I0 = Serial.read();
 I0=I0-'0';
 Serial.println(I0);

 Serial.print("I1=");
 while(Serial.available()==0){}
 I1 = Serial.read();
 I1=I1-'0';
 Serial.println(I1);

 Serial.print("I2=");
 while(Serial.available()==0){}
 I2 = Serial.read();
 I2=I2-'0';
 Serial.println(I2);

 Serial.print("I3=");
 while(Serial.available()==0){}
 I3 = Serial.read();
 I3=I3-'0';
 Serial.println(I3);


 digitalWrite(2,S1);
 digitalWrite(3,S2);
```

```
        digitalWrite(4,I0);
        digitalWrite(5,I1);
        digitalWrite(6,I2);
        digitalWrite(7,I3);

        Serial.println("Enter the values again:");


    }
```

CONCLUSION:

1) **Part A :**

S1	S2	Y
0	0	I3
0	1	I1
1	0	I2
1	1	I0

2) **Part B :**

S0	S1	y0	y1	y2	y3
0	0	I	0	0	0
0	1	0	I	0	0
1	0	0	0	I	0
1	1	0	0	0	I

3) **Part C :**

S0	S1	y0	y1	y2	y3
0	0	I0	0	0	0
0	1	0	I1	0	0
1	0	0	0	I2	0
1	1	0	0	0	I3

LINK TO THE TINKERCAD SIMULATION :

1) **Part A :**
   https://www.tinkercad.com/things/1Tehh45mGX6-lab3-parta/editel?sharecode=PzsnEOBkGnnkUD8hzFzhvFB-_lk9magqM4f3rfh8uhl
2) **Part B :**
   https://www.tinkercad.com/things/lMek3Q0W9ZF-lab3-partb/editel?sharecode=hABv6OQxehFcSRxy8T0hRtGYAmJ0-d3U1Lh7DTI6KqA
3) **Part C :**
   https://www.tinkercad.com/things/e605m1xoqgE-lab3-partc/editel?sharecode=1rcg5fWHUC1DlbPSxXNP2QLq5Xzlxg25KJTsOW6ozKE