NAME: Malla Sailesh
ROLLNUMBER:2021101106
GROUPNUMBER:6

LAB5
DIGITAL SYSTEMS AND MICROCONTROLLERS

AIM:

1) **Part A :** To construct a SR latch
2) **Part B :** To Construct a Master Slave JK Flip Flop
3) **Part C :** To construct a 4 bit Up-Down counter

ELECTRONIC COMPONENTS:

1) Arduino
2) LED
3) Resistor
4) BreadBoard
5) Integrated circuits (NOT gate , ANd gates)
6) Push Button

LINKS TO REFERENCE CIRCUITS :

1) **Part A :** https://crcit.net/c/a42e2da87d99448fbf8deaec7d47bc33
2) **Part B :** https://crcit.net/c/88f4f043057f4a30abcd9acfb70efd83
3) **Part C :** https://crcit.net/c/b830b858bc764c64b0509c1a01ba2455

PROCEDURE :

1) **Part A :**

- Assemble a NOR latch using two nor gates as shown in reference circuit
- Name the inputs as R and S
- And also name the outputs as Q and Q' where Q named corresponding to R
- Observe and tabulate the sequence of Q and Q' in response to the following input sequence: S R = 01, 00, 10, 00, 01, 10, 01, 00, 11, 00, 10, 11, 00, 01, 11, 00.
- CODE :

```
int R,S;
void setup()
{
  pinMode(2,OUTPUT);
  pinMode(3,OUTPUT);
  Serial.begin(9600);
}
void loop()
{
```

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

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

  digitalWrite(2,R);
  digitalWrite(3,S);

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

 }
```

2) **Part B :**

- **The JK master-slave flip flop consists of two latches: a master latch and a slave latch.**
- **The master latch changes its values on the leading edge of the clock, whereas the slave latch changes its values on the trailing edge of the clock.**
- **Add a Power supply to your working area. Make sure Power supply is set to 5V and 5A.**
- **Assemble NAND gates as shown in the reference circuit to form this flip flop. Ideally, you can complete this circuit using only one 74HC10 (triple input NAND) gate and two 74HC00 gates (two input NAND).**
- **Observe and tabulate the sequence of Q and Q' in response to the following input sequence: J K = 10, 00, 01, 10, 01, 00, 11, 00, 10, 11, 00, 01, 11, 00.**
- **CODE :**

```
int J,K,clk;
void setup()
{
  pinMode(2,OUTPUT);
  pinMode(3,OUTPUT);
  pinMode(4,OUTPUT);
  Serial.begin(9600);// sets the data rate to 9600 bps
}
void loop()
{
  Serial.print("J=");
  while(Serial.available()==0){}
  J = Serial.read();
```

```
 J = J -'0';
 Serial.println(J);

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

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

 digitalWrite(2,J);
 digitalWrite(3,K);
 digitalWrite(4,clk);

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

3) **Part C :**

- **Using the Timer library, implement a 4-bit counter. The bit outputs of the 4-bit ripple counter will be represented by LEDs. (One LED for each bit)**
- **Initialize a Timer t and use t.oscillate function to toggle the pin values in a predefined time period. (Each pin will have a different time period)**
- **Once the ripple counter reaches 15 (1111), make it go down to 0.You will need to stop existing timers using t.stop. You can use t.every to fire a function after a set-interval of time (hint: 2 4 time units) that will do two tasks: stop all timers and restart them in opposite direction.**
- **CODE :**

```
Timer t;
int a,b,c,d,x = 0;
void setup() {
        Serial.begin(9600);
   pinMode(13, OUTPUT);
        pinMode(12, OUTPUT);
        pinMode(11, OUTPUT);
        pinMode(10, OUTPUT);
        t.every(4000, StopAllTimers);// it goes to the function
        // stopAllTimers every 4 seconds
        oscillate();//calling the function oscillate
}
```

```
void oscillate () {
        a = t.oscillate(13, 2000, x);
        b = t.oscillate(12, 1000, x);
        c = t.oscillate(11, 500, x);
        d = t.oscillate(10, 250, x);
}

void loop() {
        t.update();
}

void StopAllTimers() {
  t.stop(a);// to stop the exisiting timers
  t.stop(b);
  t.stop(c);
  t.stop(d);
  if (x == 1)
        x = 0;
   else
        x = 1;//intially x =0 so it starts from 0 and reaches 15
  // now it should continue from 15 . so value of x must be changed
  // to 1 so that it continues from 15 to 0
  oscillate();//calling the function oscillate
}
```

CONCLUSION:

1) **Part A :**

	R	S	Q	STATE
•	1	0	0	Reset
•	0	0	0	Hold
•	0	1	1	Set
•	0	0	1	Hold
•	1	1	-	Toggle(Cannot be determined)

2) **Part B :**

	J	K	Q(t+1)	
•	1	0	1	(SET)
•	0	1	0	(RESET)
•	0	0	Q(t)	[Hold]
•	1	1	Q'(t)	[Complement]

3) **Part C :**

- The ripple counter goes UP from 0(0000) to 15(1111) and then goes down from 15(1111) to 0(0000) .

LINK TO TINKERCAD CIRCUIT :

1) **Part A :**
   https://www.tinkercad.com/things/kQRzaDNM7hf-lab5-parta/editel?sharecode=QeDn834D7F8XF0y-1aEHy_4iGtaQZhctdvhvlolJibY
2) **Part B :**
   https://www.tinkercad.com/things/aowpvCKJ1J1-lab5-partb/editel?sharecode=wwm9rKLQHnJkYndN-y7-bnZ-P_UT75vXy_ddM3OqGMM
3) **Part C :**
   https://www.tinkercad.com/things/80Hlx690zLd-copy-of-timer-starter-code/editel?sharecode=iC-L0ZnXLEYMYydhh60VF1CmtHHRtRmXZSuRW0F-Ko8