Embedded C Programming
Laboratory 8
Programs on Timer Interrupts

Task 1:
Write a C program using interrupts to do the following:
(a) Generate a 10 KHz frequency on P2.1 using T0 8-bit auto-reload
(b) Use timer 1 as an event counter to count up a 1-Hz pulse and display it on P0. The pulse is connected to EX1.
Assume that XTAL = 11.0592 MHz. Set the baud rate at 9600.

Solution:
(i) TMOD – (a) Timer 0 8-bit auto reload: 0000 0010
(b) Timer 1 as a counter: 0100 0000

Therefore, TMOD = 0100 0010 = 0x42;

(ii) TH = ?
Time = 1/f = 1/10 KHz = 100 µs
½ of the time = 50µs
Time for one machine cycle = 1.085 µs
Total clock to generate delay of 50µs = 50/1.085 = 46

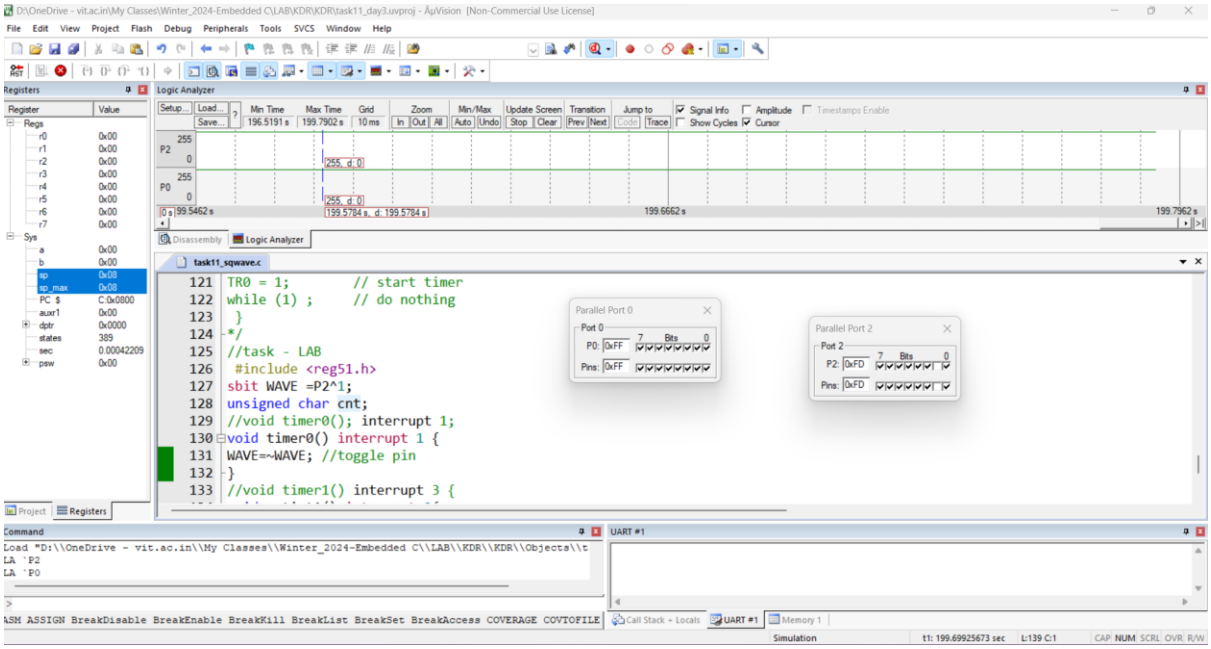
Therefore, TH = Final states – last state = 256 – 46 = 210 = 0xD2

(iii) IE : Timer 0, Ex1 : so, 1000 0110
Therefore, IE = 0x86;

```
#include <reg51.h>
sbit WAVE =P2^1;
unsigned char cnt;

void timer0() interrupt 1 {
WAVE=~WAVE; //toggle pin
}

void timer1() interrupt 3 {
cnt++; //increment counter
P0=cnt; //display value on pins
}

void main() {
```

```
cnt=0; //set counter to 0
TMOD=0x42; //0100 0000
TH0=0xD2; //10 KHz : 256-46 = 210
IE=0x86; //enable interrupts - 1000 0110
TR0=1; //start timer 0
while (1); //wait until interrupted
}
```

Output:



Task 2:

Assume that XTAL = 11.0592 MHz, write a C program continuously gets a single bit of data from PI. 7 and sends it to P1.0, Simultaneously generate a square wave of 2 kHz frequency on pin P1.5 using timer 0 mode 1. Crystal frequency is 11.0592MHz.

Solution:

(i) TMOD – Timer 0 mode 1

Therefore, TMOD = 0000 0001 = 0x01;

(ii) TH = ?; TL = ?

Time = 1/f = 1/2 KHz = 500 µs

½ of the time for the high and low pulse = 250µs

Time for one machine cycle = 1.085 µs

Total clock to generate delay of 50µs = 250/1.085 = 230

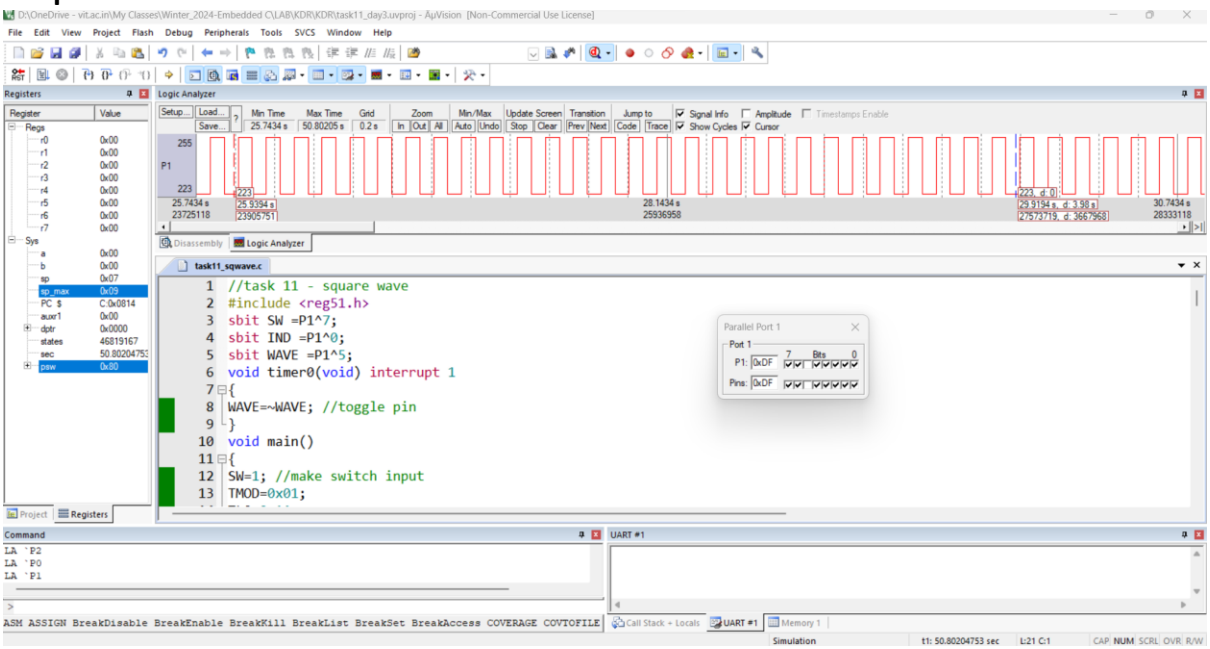
Final states – last state = 65536 – 230 = 65306 = FF1AH

Therefore, TH = FF; TL = 1A;

(iii) IE : Timer 0, Ex1 : so, 1000 0010
Therefore, IE = 0x82;

```
#include <reg51.h>
sbit SW =P1^7;
sbit IND =P1^0;
sbit WAVE =P1^5;
void timer0(void) interrupt 1
{
WAVE=~WAVE; //toggle pin
}
void main()
{
SW=1; //make switch input
TMOD=0x01;
TL0=0x1A;
TH0=0xFF; //for delay
IE=0x82; //enable interrupt for timer 0
TR0=1;
while (1)
{
IND=SW; //send switch to LED
}
}
```

Output:

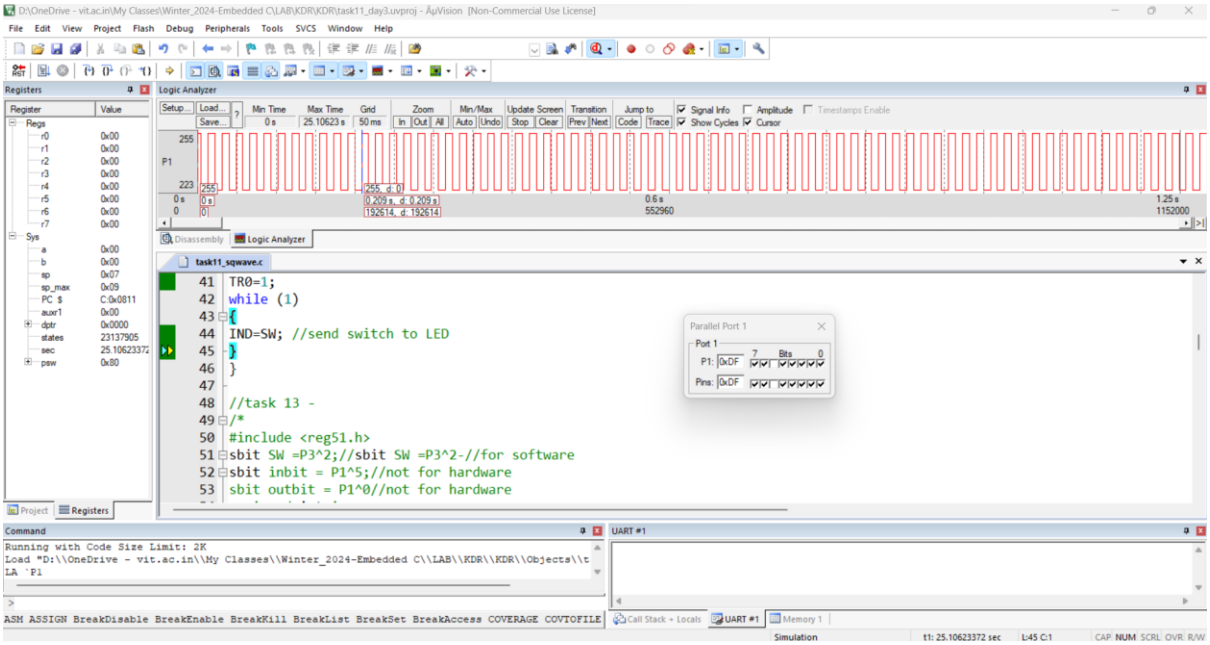


Task 3:

Write a C program that continuously gets a single bit of data from P1.7 and sends it to P1.0, while simultaneously creating a square wave of 200 µs period on pin P2.5. Use Timer 0 to create the square wave. Assume that XTAL = 11.0592 MHz.

```
#include <reg51.h>
sbit SW =P1^7;
sbit IND =P1^0;
sbit WAVE =P1^5;
void timer0(void) interrupt 1
{
WAVE=~WAVE; //toggle pin
}
void main()
{
SW=1; //make switch input
TMOD=0x20;
TH0=0xA4; //TH0=-92
IE=0x82; //enable interrupt for timer 0
TR0=1;
while (1)
{
IND=SW; //send switch to LED
}
}
```

Output:



Task 4:

Write a C program that continuously gets a single bit of data from P1.7 and sends it to P1.0, while simultaneously creating a square wave of 400 µs period on pin P2.5. Use Timer 0 to create the square wave. Assume that XTAL = 11.0592 MHz.