

## ***Embedded Systems Lab***

### ***Lab 1 Report***

#### **Question 1:**

##### **Experiment 1 Code:**

```
/* This program blinks the red LED on the
 * TI Tiva LaunchPad. The connections are:
 * PF1 - red LED
 * PF2 - blue LED
 * PF3 - green LED
 * They are high active (a '1' turns on the LED).
 */
#include "TM4C123GH6PM.h"
int flag=0;
int flag_on_off =0;
int counter_on_off =0;
int en=0;
void delayMs(int n);
int main(void)
{
    // enable clock to GPIOF at clock gating control register
    SYSCTL->RCGCGPIO |= 0x20;
    // enable the GPIO pins for the LED (PF3, 2 1) as output
    GPIOF->DIR = 0x0e;

    GPIOF->DEN = 0x1f;

    while(1)
    {

        GPIOF->DATA = 0x02; // turn on red LED

        delayMs(500);

        GPIOF->DATA = 0; // turn off red LED
        delayMs(500);

    }
}
// delay in milliseconds (16 MHz CPU clock)
void delayMs(int n)
{
```

```
SysTick->LOAD = 16000*n-1;
SysTick->CTRL = 0x5; /*Enable the timer and choose sysclk */
while((SysTick->CTRL & 0x10000) == 0) /*wait until the Count flag is set */
{
    SysTick->CTRL = 0; /*Stop the timer (Enable = 0) */
}
```

### Experiment 2 Code:

```
/* This program blinks the red LED on the
 * TI Tiva LaunchPad. The connections are:
 * PF1 - red LED
 * PF2 - blue LED
 * PF3 - green LED
 * They are high active (a '1' turns on the LED).
 */
#include "TM4C123GH6PM.h"
int flag=0;
int flag_on_off=0;
int counter_on_off=0;
int en=0;
void delayMs(int n);
int main(void)
{
    // enable clock to GPIOF at clock gating control register
    SYSCTL->RCGCGPIO |= 0x20;
    // enable the GPIO pins for the LED (PF3, 2 1) as output
    GPIOF->DIR = 0x0e;
    // enable GPIO pins PF0 and PF4 as input
    GPIOF->DIR&= ~0x11;
    // enable the GPIO pins for digital function
    //specified by the datasheet

    GPIOF->LOCK =0x4C4F434B;
    GPIOF->CR |= 0xff;
    GPIOF->PUR |= 0x11;
    //GPIOF->PUR = 0;
    GPIOF->DEN = 0x1f;

    //while((GPIOF->DATA & 0x10)==0){}
    while(1)
    {
        if((GPIOF->DATA & 0x10)==0){
            delayMs(2000);
        }
    }
}
```

```
        if((GPIOF->DATA & 0x10)==0)        flag =(flag +1)%3;
    }

    if((GPIOF->DATA & 0x01)==0){
        delayMs(2000);
        if((GPIOF->DATA & 0x01)==0)        flag_on_off =(flag_on_off +1)%2;
    }

    if(flag==0 && flag_on_off==0){
        GPIOF->DATA = 0x02; // turn on red LED
        delayMs(250);
        GPIOF->DATA = 0; // turn off red LED
        delayMs(250);
    }
    if(flag==1 && flag_on_off==0){
        GPIOF->DATA = 0x04; // turn on red LED
        delayMs(250);
        GPIOF->DATA = 0; // turn off red LED
        delayMs(250);
    }
    if(flag==2 && flag_on_off==0){
        GPIOF->DATA = 0x08; // turn on red LED
        delayMs(250);
        GPIOF->DATA = 0; // turn off red LED
        delayMs(250);
    }
}

}

// delay in milliseconds (16 MHz CPU clock)
void delayMs(int n)
{
    SysTick->LOAD = 16000*n-1;
    SysTick->CTRL = 0x5; /*Enable the timer and choose sysclk */
    while((SysTick->CTRL & 0x10000) == 0) /*wait until the Count flag is set */
    {}
    SysTick->CTRL = 0; /*Stop the timer (Enable = 0) */
}
```

## **Question 2:**

**Link to Youtube video: <https://youtu.be/YeicvVUpQS8>**

```
/* This program blinks the red LED on the
 * TI Tiva LaunchPad. The connections are:
 * PF1 - red LED
 * PF2 - blue LED
 * PF3 - green LED
 * They are high active (a '1' turns on the LED).
 */
#include "TM4C123GH6PM.h"
int flag=0;
int flag_on_off =0;
int counter_on_off =0;
int en=0;
int volatile temp;
int volatile delay=0;
double volatile freq=0;
void delayMs(int n);
int main(void)
{
    // enable clock to GPIOF at clock gating control register
    SYSCTL->RCGCGPIO |= 0x20;
    // enable the GPIO pins for the LED (PF3, 2 1) as output
    GPIOF->DIR = 0x0e;
    // enable GPIO pins PF0 and PF4 as input
    GPIOF->DIR&= ~0x11;
    // enable the GPIO pins for digital function
    //specified by the datasheet

    GPIOF->LOCK =0x4C4F434B;
    GPIOF->CR |= 0xff;
    GPIOF->PUR |= 0x11;
    //GPIOF->PUR = 0;
    GPIOF->DEN = 0x1f;

    SYSCTL->RCGCGPIO |= 0x04;
    GPIOC->DIR = 0x0e;
    GPIOC->DEN = 0x1f;

    //while((GPIOF->DATA & 0x10)==0){}
    freq = 1.5;
    delay = 500/freq;
```

```
while(1)
{
    if((GPIOF->DATA & 0x10)==0){
        freq+=0.3;

        delay=500/freq;

        //delayMs(2000);
        //if((GPIOF->DATA & 0x10)==0)    flag =(flag +1)%3;
    }

    if((GPIOF->DATA & 0x01)==0){
        freq-=0.3;
        if(freq<0){
            delay = 1000000000;
            freq=0;
        }
        else delay=500/freq;

        //delayMs(2000);
        //if((GPIOF->DATA & 0x01)==0)    flag_on_off =(flag_on_off +1)%2;
    }

    GPIOC->DATA = en? 0x02:0;
    temp = 0x02&GPIOC->DATA;
    GPIOF->DATA = temp; // turn on red LED
    en=!en;
    delayMs(delay);

}

}

// delay in milliseconds (16 MHz CPU clock)
void delayMs(int n)
{
    SysTick->LOAD = 16000*n-1;
    SysTick->CTRL = 0x5; /*Enable the timer and choose sysclk */
    while((SysTick->CTRL & 0x10000) == 0) /*wait until the Count flag is set */
    {}
    SysTick->CTRL = 0; /*Stop the timer (Enable = 0) */
}
```

### **Question 3:**

**Link to video: <https://youtu.be/XWyTLJ-Vuj0>**

```
/* This program blinks the red LED on the
 * TI Tiva LaunchPad. The connections are:
 * PF1 - red LED
 * PF2 - blue LED
 * PF3 - green LED
 * They are high active (a '1' turns on the LED).
 */
#include "TM4C123GH6PM.h"
int flag=0;
int flag_on_off =0;
int counter_on_off =0;
int volatile en=0;
int volatile temp;
int volatile delay_on=0;
int volatile delay_off=0;
double volatile freq=0;
void delayMs(int n);
int main(void)
{
    // enable clock to GPIOF at clock gating control register
    SYSCTL->RCGCGPIO |= 0x20;
    // enable the GPIO pins for the LED (PF3, 2 1) as output
    GPIOF->DIR = 0x0e;
    // enable GPIO pins PF0 and PF4 as input
    GPIOF->DIR&= ~0x11;
    // enable the GPIO pins for digital function
    //specified by the datasheet

    GPIOF->LOCK =0x4C4F434B;
    GPIOF->CR |= 0xff;
    GPIOF->PUR |= 0x11;
    //GPIOF->PUR = 0;
    GPIOF->DEN = 0x1f;

    SYSCTL->RCGCGPIO |= 0x04;
    GPIOC->DIR = 0x0e;
    GPIOC->DEN = 0x1f;

    //while((GPIOF->DATA & 0x10)==0){}
```

```
    delay_on=500;
    delay_off=500;

    while(1)
    {
        if((GPIOF->DATA & 0x10)==0){
            if(delay_off<=0){
                delay_on=1000;
                delay_off=0;
            }else{
                delay_on+= 500*0.5;
                delay_off-=500*0.5;
            }
        }

        if((GPIOF->DATA & 0x01)==0){
            if(delay_on<=0){
                delay_on=0;
                delay_off=1000;
            }else{
                delay_on-= 500*0.5;
                delay_off+=500*0.5;
            }
        }

        if(delay_on>0){
            GPIOC->DATA =0x02;
            temp = 0x02&GPIOC->DATA;
            GPIOF->DATA = temp; // turn on red LED
            delayMs(delay_on);
        }

        if(delay_off>0){
            GPIOC->DATA =0;
            temp = 0x02&GPIOC->DATA;
            GPIOF->DATA = temp;
            delayMs(delay_off);
        }

    }
}

// delay in milliseconds (16 MHz CPU clock)
void delayMs(int n)
```

```
{  
    SysTick->LOAD = 16000*n-1;  
    SysTick->CTRL = 0x5; /*Enable the timer and choose sysclk */  
    while((SysTick->CTRL & 0x10000) == 0) /*wait until the Count flag is set */  
    {}  
    SysTick->CTRL = 0; /*Stop the timer (Enable = 0) */  
}
```