ECE 355 Midterm Exam Solutions (2024)

1. (You do **NOT** need to write down **#define** statements.)

```
interrupt void intserv();

volatile unsigned char digit1 = 0;        /* DIGIT1 for display */
volatile unsigned char digit2 = 0;        /* DIGIT2 for display */
volatile unsigned char leds = 0x20;       /* LED1 on, LED2 off */

int main() {

  *PADIR = 0xFF;         /* Set Port A direction */
  *PBDIR = 0x22;         /* Set Port B direction */

  *CTCON = 0x2;          /* Stop Timer (if running) */
  *CNTM = 100000000;     /* Initialize: 1-s timeout */
  *CTSTAT = 0x0;         /* Clear "Reached 0" flag */

  *IVECT = (unsigned int *) &intserv;     /* Set interrupt vector */
  asm("MoveControl PSR,#0x40");           /* CPU responds to IRQ */
  *CTCON = 0x11;              /* Start Timer, enable interrupts */

  *PAOUT = 0x00;                    /* Initialize port A */
  *PBOUT = 0x20;                    /* Initialize port B */

  while (1) {
    while ((*PBIN & 0x04) != 0);    /* Wait for SW press */
    while ((*PBIN & 0x04) == 0);    /* Wait for SW release */
    leds ^= 0x22;                   /* Toggle LED states
    *PBOUT = leds;                  /* Update port B
  }

  exit(0);

}


interrupt void intserv() {

  *CTSTAT = 0x0;                    /* Clear "Reached 0" flag */

  if (leds == 0x20) {
    if (digit1 == 0) digit1 = 9;
    else digit1 = digit1 - 1;       /* Decrement DIGIT1 */
  }
  else {
    if (digit2 == 0) digit2 = 9;
    else digit2 = digit2 - 1;       /* Decrement DIGIT2 */
  }

  *PAOUT = (digit2 << 4 | digit1);  /* Update port A */

}
```

2.

t=0: T1
t=20: T2
t=35: T3
t=40: T1 (T3 preempted)
t=60: T3
t=75: T2
t=90: T1
t=110:Idle
t=120:Repeat…

3.