ECE 355 Midterm Exam Solutions (2021)

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 = 0x1; /* LED1 on, LED2 off */

int main() {
  *PADIR = 0x6F; /* Set Port A direction */
  *PBDIR = 0xF0; /* 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 */
  *PAOUT = 0x20; /* Initialize port A */
  *PBOUT = 0x00; /* Initialize port B */
  *CTCON = 0x11; /* Start Timer
  while (1) {
    while ((*PBIN & 0x01) != 0); /* Wait for SW press */
    while ((*PBIN & 0x01) == 0); /* Wait for SW release */
    leds ^= 0x1; /* Toggle LED flag
    *PAOUT ^= 0x60; /* Flip LED1/LED2 state
  }
  exit(0);
}

interrupt void intserv() {
  *CTSTAT = 0x0; /* Clear "Reached 0" flag */
  if (leds == 0x1) {
    if (digit1 == 0) digit1 = 9;
    else digit1 = digit1 - 1; /* Decrement DIGIT1 */
    *PAOUT = (0x20 | digit1); /* Update port A, LED1 on, LED2 off */
  }
  else {
    if (digit2 == 0) digit2 = 9;
    else digit2 = digit2 - 1; /* Decrement DIGIT1 */
    *PBOUT = digit2 << 4; /* Update port B */
  }
}
```

2.

t=0: T1
t=10: T2
t=20: T3
t=30: T1
t=40: T2

t=50: T4
t=60: T1 (T4 preempted)
t=70: T4
t=75: T3
t=85: T2
t=90: T1 (T2 preempted)
t=100:T2
t=105:Idle
t=120:Repeat…

3.