NCSU - ECE 306- Exam 2 – March 27, 2003

Name: _____ User ID _____

Question	1-15	16-22	23-Algo	23-code	Total
Score	/45	/60	/15	/30	/150

You are permitted 75 minutes to take this test, no more. This is an open book/open notes test. You are allowed the following items for the test: calculators, books, notes, homework, labs, pencils and erasers. You are not permitted to have any of the following on your desk during the test: computer, or other electronic assistance. Failure to abide by this policy will result in a zero for the test and a visit to the NCSU judicial board. Put your answers on this paper. Use only this paper.

Please read and sign this statement: I have not received from anyone nor assisted others while taking this test. I have also notified the test proctor of any of these violations noted above.

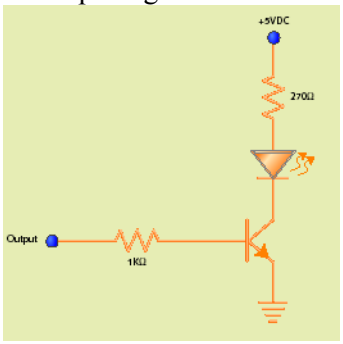
Signature: _____

Multiple Choice - Questions 1-15: Each of these multiple choice questions is worth 3 points for a correct answer, 0 points for an incorrect answer. Circle the correct answer. Multiple circles will be marked as incorrect.

1) Which of the following 8 bit numbers have a parity bit of 1, assuming odd parity:
   I) 00100101 II) 11111111 III) 00000001
   a. A) I only
   b. II only
   c. III only
   d. I and II
   e. I and III

2) According the ECE 306 programming standards, which of the following should be included in the header of a subroutine?
   a. Your name
   b. Assumptions
   c. Inputs/Outputs
   d. Interfaces
   e. All of the above

3) Which output signal will enable the LED in the circuit shown below?



   a. Low Output Signal
   b. High Output Signal
   c. Any Voltage Level

4) What is meant by the term “race conditions”?
   a. A comparison that is based on which device interrupts first.
   b. A standard ratio that grades the overall performance of an embedded system.
   c. The unpredictable nature of a variable at a certain time due to the hardware implementation and the time that it takes a signal to propagate.
   d. The competition between two devices that share the same interrupt priority.
   e. The optimal conditions for running a specific interrupt to create the fastest execute time.

5) What is “Handshaking?”
   a. what you do when you meet a fellow employee
   b. a predetermined process by which 2 or more devices talk to each other
   c. any communication between 2 hardware devices
   d. the process of one device sending a signal to a receiving device
   e. an interrupt

6) In the article “Introduction to Interrupt Debugging”, what are the three major pitfalls to avoid in ISRs?
   a. software complications, hardware complications, CPU utilization
   b. race conditions, hardware complications, and stack overflow
   c. race conditions, software complications, and CPU utilization
   d. software complications, stack underflow, CPU utilization
   e. None of the above

7) Which of the following code is used to set timers X, Y, Z to 16MHz and divide by 8:
   a. tcss = SRC_SEL;
   b. tz = src;
   c. txyz = sel_xyz;
   d. pd3_0 = 1;
   e. txyz = sel;

8) Overhead in an embedded system refers to:
   a. The cost of a project.
   b. Instructions and operations that do not advance the computation of the embedded system.
   c. The latency of an interrupt.
   d. The time it takes for the code to perform it's operation.
   e. None of the above

9) When creating an active low switch, what hardware component should be implemented in order for the switch to work correctly?
   a. A pull down resistor
   b. A pull up resistor
   c. An LED
   d. A capacitor with a very high capacitance
   e. A capacitor with a very low capacitance

10) What is a way to test interrupt latency as described in Interrupt Latency by Jack Gannsel?
   a. Take a timer and see how fast it can fire incrementing a counter and outputting the counter after a second.
   b. Find out the processor speed and calculate the amount of time it takes to execute one instruction.
   c. Turn an LED on at the beginning of one interrupt and turn the same LED off at the beginning of another interrupt.
   d. Set a parallel output bit high at the beginning of an interrupt and set it low at the end of the interrupt, attach an oscilloscope to the parallel output bit.
   e. none of the above

11) According to Michael Gauland's article "Twiddle Bits," why are LEDs not directly connected to the output pins of programmable logic, like a microprocessor?
    a. LEDs are analog devices, and cannot correctly be integrated with a digital circuit.
    b. The pins from the microprocessor usually cannot provide enough output current to power the LED; instead, the output pin is connected to the 'gate' terminal of a transistor, and the LED will illuminate when the output voltage is correct.
    c. The LED, when interfaced with a digital circuit, cannot decipher between the ground and output voltages. As a result, the LEDs are always reverse biased.
    d. The typical voltages coming from the output of a digital chip are too high for a LED to handle, even when a resistor connected in series with the LED.
    e. Mr. Gauland is mistaken. LEDs can always be connected directly to the output pins, and none of the above answers are correct.

12) The "sect30.inc" file contains the following
    a. RAM and ROM start address
    b. Vector Table
    c. LCD parameters
    d. B and C
    e. A and B

13) What is true about hardware interrupts?
    a. they are not used very often
    b. they are synchronous
    c. they are asynchronous and not related to the code the processor is currently executing.
    d. they are related to the code the processor is currently executing
    e. they are not as good as software interrupts

14) What is an important test policy(s) for keeping a programming project on time and on budget?
    a. Testing should only be done after all the code has been done.
    b. Only a little testing should be done so there is less chance that it will make those who worked on the project look bad.
    c. Test early and often.
    d. Test randomly.
    e. All of the above

15) As listed in the course notes, which of the following is NOT a major phase of a software project?
    a. Specification
    b. Coding
    c. Requirements Gathering
    d. Functional Testing
    e. Debugging

Short Answer

16) Below are five statements regarding describing the methods in which a microprocessor handles interrupt requests when interfaced with a Programmable Interrupt Controller (PIC). In what order do the following statements occur? Write the letter of the statement in the five blanks provided. Each statement is used ONCE. (10 points)

Order of Execution:	Statements:
1: _____	a) The PIC signals the microprocessor that an interrupt has occurred.
2: _____	b) The microprocessor communicates with the interrupting device, then executes the Interrupt Service Routine
3: _____	c) A device generates an interrupt, and sends the request to the PIC
4: _____	d) The PIC reports the priority level of the interrupt to the microprocessor
5: _____	e) The microprocessor requests the priority level of the interrupt from the PIC

17) **Completion:** List all the activities in an order (1, 2, 3, etc.) when an interrupt is called (10 points):

____Read address 00000h for interrupt source information
____Set interrupt priority level in IPL
____ISR should save any registers which will be modified (compiler does this automatically
____Push the temporary register (which has old FLG) onto stack
____Fetch interrupt vector from vector table
_1__Finish or interrupt current instruction
____Clear the following flags: a) Interrupt enable - I; b) Debug – D; c) Stack pointer select – U
____Start executing ISR at the target of the vector
____Push PC onto stack
____Save flag register FLG in temporary register

18) What is Pseudocode and what must it include? (5 points)

19) What development environment is not great for embedded program development and why? (5 points)

20) What is the difference between hardware and software interrupts? Be specific. (10 points)

21) What is wrong with the following code? Be specific. (10 points)

```
#include "sfr10.h"

#define LED_R p3_0
#define LED_ON (0)
#define LED_OFF (1)

unsigned int tchi = 0;

void init_LEDs ( ) {
   pd3_1 = 1;  // outputs
   LED_R = LED_OFF;  // LEDs off
}

void timer_isr ( ) {
   tchi++;
}

void main ( ) {
   unsigned int a = 0, b = 0;
   init_LEDs ( );
   LED_R = LED_ON;
   tcc00 = 1;
   tcc01 = tcc02 = 0;
   tcic = 4;
   while (1) {
         a = tc;
         b = tc;
   }
}
```

22) Write a segment of C code that will display your name to the LCD. Use the disp_dataw() function and display one letter at a time (10 points)

23) Write the algorithm, then the C code of a subroutine which will do the following:
- Req 1: Will be called by the C code SendInfo("SendThisString");
- Req 2: Will send the string "Ready?\n" via the RS-232 port 1, then will wait for the character "R" via the RS-232 port 1 before sending the passed string.
- Req 3: Will abort the whole communication if Switch 2 is pressed while waiting for the "R" character.
- Req 4: Will never overwrite communications buffers.
- Req 5: Will send the strings as quickly as possible.
- Req 6: Will light the green LED when completed succesfully.
- Req 7: Follows the ECE 306 programming standards (i.e. comments).
- Req 8: xxxxxxxxxxxxxxxxxx

Assume the RS-232 port has been set up correctly already. (15 points algorithm, 30 points code)