**v** Name:

**Mechatronics S-12 Exam 1 March 15, 2017**

**Instructions: In-class portion** you may use a 1 page note sheet.

**Programming portion:** You sign up for a 2 hour block. Go to the mechatronics lab to do test work during that time. Do not open the exam until you start the exam. You may use notes, information on the iLearn class page or matlab-nsf wiki, or any code you created in your labs. Demo your exam at the end of the 2 hour block to instructor.

**# 1**: (10%) Matching:

|  |  |  |
| --- | --- | --- |
| **Questions** | Match | **Match** |
| 1) This number in decimal: 00010011 |  | a) 20 or more |
| 2) Ports connected to ADC on the ATmega 2560 |  | b) Assembly |
| 3) character used to represent a binary number in C |  | c) 19 |
| 4) Making America great again, one tweet at a time |  | d) 0b |
| 5) Character used to represent a hex number in C |  | e) 166 |
| 6) Number of microcontrollers in a modern automobile |  | f) Donald Trump |
| 7) Programming language that works in the basic machine instruction set |  | g) 0X |
| 8) This number in decimal: A6 |  | h) Ports |
| 9) T/F: There should be a TV show about Mechatronics |  |  |
| 10) T/F: Learning the C language should satisfy my humanities language requirements |  |  |

B

C

E

**# 2:** (5%) Fill in the Blank:

1. Which type of transistor is shown:
2. In order to forward bias the transistor shown, what needs to happen to the voltage at B
3. Typical voltage drop over LED when it is forward biased (emitting light)

4) What is the equation for axial stress

5) What are the units of modulus of Yield strength (use metric system)

**#3** (20%) Construct a circuit diagram with labels for a system that has two momentary switches (SW1 and SW2) on ports PA0 and PB0 respectively of the ATmega2560 such that PA0 reads high when SW1 is pressed and PB0 reads low when SW2 is pressed.

**#4** (20%) write a statement using C syntax that will check the switches from problem 3 and print to the serial monitor, “SW1 pressed”, “SW2 pressed”, or “no switch pressed” depending on the state of the switches being pressed (assume only 1 switch pressed at a time). The serial monitor should only show one print statement for each unique event (i.e., print only one time if a switch is pressed, or print only one time if switches are released).

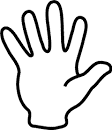
Graduate credit: Implement one method to prevent or alieve switch bouncing (HW or SW).

**#5:** (20%) Scott is 3D printing an anthropomorphic hand with plastic tendons made from extruded nylon 6/6, Sult =12.4MPa, 0.1cm in diameter. They are connected to an RC servo motor horn with 1cm radius, RC servo MG995R with 8 kg-cm (or 8\*9.81 N-cm) torque. Will the nylon fail?

RC

Servo

1 cm radius



tendon

**# 6:** (40%) Do one of the following. Circle your rank and the problem you attempt. Maximum time: 2 hrs: Create a program to complete the following task. Print your program and attach to this sheet. Demonstrate operation of the program on your ATMega 2560 during demo times.

Rank your programming / MCU skill as:

|  |  |  |  |
| --- | --- | --- | --- |
| Level | Beginner | Intermediate | Advanced |
| Factor | 110 | 105 | 100 |

Your possible grade is factor \* value.

Level A: (Beginner) (value is 80%)

Create a set of “chaser” leds that travel around a 7 segment display and repeat continuously. Have them travel at a speed of approximately 2 hz. Have the system start by pushing SW2, stop by pushing SW5.

Level B: (Intermediate) (value is 90%)

Level C: (Intermediate 2) (value is 100%)

Level D: (Intermediate 3) (value is 105%)

Level D: (Advanced) (value is 110%)