**ENGR 122** **Homework 12**

**NOTE:** INDIVIDUALS: Use engineering format for problems 1 through 4. Each student should turn in problems 1 through 4 separately from the team homework.

TEAMS: Complete problem 6 through 10 as a team, and turn in one paper for each team. Use non-engineering format for these problems. Write the names of all team members on the paper that you turn in for the team. This homework will be part of your design journal due class 19. Make an electronic copy of this homework for your records before you submit it.

1. Jan took out a 30-year mortgage that calls for monthly payments of $1,350. If the interest rate on the loan is 4.53% per year compounded monthly, what is the total amount of money borrowed? **$265,502.70**

2. Uncle Fred decides that he'd like to build his own giant Arduino-Bot to ride. How much would Uncle Fred need to save per month if he wanted to be able to pay for his $20,000 giant robot in 5 years? Assume monthly compounding with 6% annual interest. **$286.66**

3. An amateur art collector finds a rare painting for sale on e-bay, and she knows the painting could be valued near $12,000 if it is authentic. She is confident that she can get a loan to pay for the painting. With a bid of $8000, she wins the painting.
    a. If she gets a 60-month loan with an annual interest rate of 9%, how much will she need to pay monthly? Assume monthly compounding. **$166.07**
    b. What is the total amount of money that she will pay for the painting (add all her payments)? **$9,964.20**

4. John would like to buy an RV to fulfill his dream of travelling across the country and camping at every national park.
    a. He knows that the RV will cost him $140,000. How many years will it take him to save the money if he saves $3,000 per year with an interest rate of 6% compounded annually? Assume he puts the first $3,000 in the bank at the end of the first year. **22.911 years**
    b. Let's look deeper at the answer of 22.911 years provided in part a. How much will John have in the bank immediately after making his deposit at the end of year 22? **$130,176.81**
    c. If he does not make another deposit in the savings account, how much will he have at the end of year 23? Assume annual compounding as before. **$137.987.48**
    d. Given the scenario and answer to part c, will he have enough money to purchase the RV after year 23? Explain why or why not.

5. **(Due Class 15)** As an engineer in a world that is becoming increasingly "flat," It is very likely that you will work with people from other cultures during your career. Using the Internet and other sources, learn about cultural differences to help you prepare for these future interactions.

    Pick a country other than your native country and discuss some of the things that you would need to consider when interacting with these people. Write a couple of paragraphs describing what you have learned (about ½ page is fine), and come to class ready to participate in an open discussion on this topic. **We expect you to spend about one hour completing this problem; this is not meant to be an exhaustive study of the topic.**

***This is the start of the team homework. Please submit one paper per group. Use non-engineering format for your solutions.***

6. Choose one person in your group who will present an elevator pitch to the class. The pitch should be no longer than 1 minute and should grab the audience's attention. The pitch should introduce the project, define the problem being solved, and tell how you plan to solve the problem.

Even though only one person is presenting the pitch. The entire group should contribute to the pitch, practicing together and to make sure the pitch is clear. This pitch can be the start of your presentation to the judges for the Design Expo.

7. Email your professor a Word document with a brief description of your product using the format below. Only one submission is needed per group. This description will be printed in the Design Expo Program. Please work on the wording to make it as clear and concise as possible. Be sure to use proper grammar. Try not to make the description longer than the one shown below. Print out a copy to include with your homework.

   Project Name: RC Doggie

   Team Members: Sally Doe, John Deere, Sam Eastwing, Janet Westwing

   Project Description: Dogs are routinely used in search and rescue operations. Many times, the ground area to search is large with terrain that is difficult for humans to pass. Our concept utilizes radio frequency signals transmitted from a command center to a dog (wearing the harness) some distance away to direct the dog in a systematic way. The dog harness is equipped with four vibrating motors placed on the dog's left and right shoulders, back and neck; when these motors are activated, the dog moves accordingly. The harness is also equipped with a GPS sensor and an RF transmitter to relay the position of the dog back to base which has a corresponding RF receiver. When the dog stops following the commands from the vibrating motors, as determined by a non-changing GPS location, then the search has been successful, and the humans move in to check things out.

   Sensors and Actuators: Two Arduinos, two RF transmitter / receiver pairs (Parallax 433 MHz RF Transceiver Package), five cell phone vibrating motors, one Parallax GPS receiver module

8. Start to build your third prototype. This prototype should have many of the characteristics of your final product. You should be moving toward incorporating all sensors and actuators onto the design. Focus on getting all sensors working, not necessarily implemented on you project. For example, if you will be using an accelerometer to measure angles, then implement a program that can measure angles from your Arduino, even if the accelerometer is not yet attached to your prototype. If you are using multiple sensors, be thinking about how you will structure your Arduino sketch to include input from all sensors (and output to your actuators). For your homework, please list the sensors and output devices associated with your project and their current status:
   a. Implementation not started for this sensor / device
   b. Sensor / device implemented separately
   c. Sensor / device implemented with other sensors and/or output devices
   d. Sensor / device fully integrated into prototype

   A given sensor could have a status of b and d, which would mean you still need to do some programming work related to the sensor, but other than that, it's ready to go. An example of what your homework should look like is shown below:

| **Sensor / Device** | **Status** | **Comments** |
|---|---|---|
| Accelerometer | b, d | Program gives the angle, and sensor has been attached to the prototype |
| Ping))) | a, d | Need to program this sensor ASAP, sensor integrated into prototype |
| Servos | c | Implemented and everything seems to work |

9. Bring what you need to class next time to work on your prototype; while it's not necessary to work on your prototype in class, you do have a limited amount of time to use the classroom equipment. It's also a good time to talk with your instructor about technical issues. Only a few more class periods remain before the Design Expo. Be sure to bring your safety glasses if you plan to do any fabrication.