Homework 5 **ENGR 130, AU 23**

Question 1 will be submitted through MATLAB Grader, but you will also submit your code for it, along with your solutions for Questions 2 and 3 as a single .m file. Question 4 is a very short video and brief quiz. Follow all instructions in the Assignment Submission Guide posted in the Canvas Resources area. Failure to do so will result in a reduced (or possibly zero) grade.

Question 1 (3 points)

Go to the assignment HW5 – MATLAB Grader and complete the assignment that is linked there. Include a copy of the code you submit to MATLAB Grader in your submission to Canvas.

Question 2 (8 points)

The Case Rocket Team (which TAs Will, Joey, or Abby would be happy to tell you more about) wants you to generate some simulation data for their 2023-24 rocket, *Eclipse*.

If the rocket is launched straight up from an initial height of 0, the relationships below can be used to find the height of the rocket at any time. As a first approximation, assume air drag is negligible and so the acceleration is constant. (We know this isn't true, but it's a good place to start, and once the basic code works, more complexities could be added, if we wanted.) With these assumptions, the velocity, *v*, and height, *h* of the rocket can be found using the relationships below.

$$v = v_{initial} - gt \qquad\qquad h = v_{initial}t - \frac{1}{2}gt^2$$

g is the acceleration due to gravity, 9.8 m/s^2. The velocity is in m/s, the height is in m, and time is in seconds.

Calculate the velocity and height of the rocket every 0.075 s during its flight, using a **while loop**. Start at t = 0 with an initial upward velocity of 140 m/s. While knowing a bit of physics is helpful to check your work, MATLAB can carry the weight of physics to (almost) make physics knowledge unnecessary! We know that the rocket's flight will end when it returns to the ground, so the loop should stop once the height value becomes equal to or less than zero. Store the time, velocity, and height in three separate vectors. Create two separate figures, one for the height vs. time plot and one for velocity vs. time. Each plot should be titled, and axes should be labeled with units. Use a more informative title than "velocity vs. time," etc. – the title should tell something about the situation. Make sure both figures can be viewed at the same time.

Question 3 (8 points)

A package of humanitarian aid supplies is being dropped from a plane. The plane and package are flying at a horizontal velocity of v_x = 200 m/s at an altitude of y_o = 1000 m when the package is released. Write a MATLAB script to analyze the path of the package from the moment it is dropped until it reaches a height just under 185 m, where its parachute will deploy. Your script should do the following things:

- Calculate the x (horizontal) and y (vertical) coordinates for every 0.1 seconds until the package passes below 185 m. The following relationships can be used to find the coordinates *t* seconds after the release:

  $$x = v_x t \qquad\qquad y = y_o - \frac{1}{2}gt^2$$

  where g is the acceleration due to gravity
- Plot the coordinates. Include an informative title and axis labels.
- Choose 10 of the plotted points using any method you like. Mark them on the graph.
- Use `polyfit` and `polyval` with those 10 points to make a linear fit and add that plot to the graph.
- Repeat the above step for a quadratic fit.
- Add a legend to the graph.

Be sure that you format the graph so that the viewer can easily distinguish the four different items that you plot.

Question 4 (4 points)

View the video on oscilloscopes linked in the assignment on Canvas and complete the short Homework 5 Quiz.