MAE 150 - Spring 2024
Homework 3

<u>**Submission instructions**</u>**:**

Submit **hw3.zip** on CANVAS and also a report on Gradescope by **11:59 PM on Monday 04/29/2024**. The answers on the report must be the same as the outputs from the MATLAB code in the zip file. No credit will be given if the code has syntax error.

Code submission in CANVAS: Follow the homework solution template. You must show all work in order to get credit. Put all answers in a MATLAB script Create a zip archive named **hw3.zip**. The zip archive should include the following files: **hw3.m** and all SolidWorks parts that you make in this assignment. Make sure that all six figures are plotted when hw3 script is executed.

Report submisison in Gradescope: Report the answers (i.e., the requested outputs and figures from MATLAB, SolidWorks, hand calculation / derivation) in a PDF file. Submit the file in Gradescope.

<u>**Problem 1**</u>**: (20 points)**

Consider the curve $y = x^2$ for $x \in [-2, 2]$.

(a) Construct four offset curves with the (upward) distance D = 0.25, 0.5, 0.75, and 1. Create **figure 1** to show the parabola and the four offset curves. Remember to include axis labels, title and legend. Set **p1a = 'See figure 1'**.

(b) Create **figure 2** with two panels on top of each other. Plot the radius of curvature R of the parabolic curve versus x on the top panel and the curvature K on the bottom panel. Be sure to include axis labels, title and legend. Set **p1b = 'See figure 2'**.

(c) What happens to the offset curves when the offset distance D exceeds the radius of curvature? Put the answer in **p1c = '...'**.

<u>**Problem 2**</u>**: (20 points)**

	x	y	dy/dx
curve # 1	-1	0	10
	0	1	-10
curve # 2	0	1	-10
	1	0	-10
curve # 3	1	0	5
	-1	0	-5

Use the cubic Hermite spline method to construct three curves with the data points given in the table above. Create **figure 3** to show the curves. Remember to include axis label, title and legend. Set **p2 = 'See figure 3'**.

<u>Problem 3</u>: (40 points)

(a) Generate the displacement, velocity, acceleration, and jerk profiles for one revolution (0 - 360°) of a cam with the following specifications:

- 3-4-5 polynomial rise ($0° \leq \theta \leq 110°$) 0 mm to 10 mm
- Dwell ($110° \leq \theta \leq 120°$) (keep displacement constant)
- Cycloidal rise ($120° \leq \theta \leq 200°$) 10 mm to 20 mm
- Dwell ($200° \leq \theta \leq 220°$) (keep displacement constant)
- Harmonic fall ($220° \leq \theta \leq 340°$) 20 mm to 0 mm
- Dwell ($340° \leq \theta \leq 360°$) (keep displacement constant)

The cam is driven by a constant speed motor rotating clockwise at 1,000 rpm. Create **figure 3** with four panels on top of each other to show the displacement, velocity, acceleration and jerk profiles. Be sure to label axes with proper units and give each panels a title. Set **p3a = 'See figure 4'**.

(b) Plot the pitch curve, cam contour, prime circle, and base circle for the cam specified above in rectangular coordinates on the same graph axis. Make sure that on your plot you provide a legend, title, and labels on your axes to distinguish your curves. Assume a prime circle of radius 20 mm, a follower offset of zero (e = 0), and a follower roller radius of 6 mm. Set **p3b = 'See figure 5'**.

(c, d) Plot the pressure angle as a function of θ. Set **p3c = 'See figure 6'**. Is this a good CAM design? If it is not good, how can you fix it? Give a simple one-sentence answer as **p3d = '...'**.

<u>Problem 4</u>: (20 points) SolidWorks tutorial

If you follow the wheelbarrow tutorial: Work through lessons 4 and 5. At this time, you should have completed all parts of the wheelbarrow and assemble them together. Include the screenshot of the final assembly in the SolidWorks window with a time/date stamp in your report .

If you follow SolidProfessor tutorial: Follow the “Assemblies” tutorial lessons which will require a baseline test and review test at the end of the lessons. Complete Practice Exercises: (1) Link Drive and (2) Cylinder crankshaft. Include screenshots of the parts in the SolidWorks window with a time/date stamp in your report.

Note: To show a time/date stamp on your screenshot, first save the file locally, then click File $\rightarrow$ Properties in SolidWorks. Type your name into the Author field. In the Summary Information menu that appears, you will see the date creation and modification dates and times. Move the part to one side of the screen, summary window to the other, and take a screenshot for submission.