Mathematica Project 1: due September, 10th (IN CLASS)
Multivariate Calculus, MTH 212, Fall 2019

Note: late projects will not be accepted.

Use the text input mode to start your Mathematica notebook with your name and project number. Your project should be well-organized and clear to read; make sure all the exercises are clearly labeled and all questions answered. (Failure to follow these directions will result in lost points.) Make sure that you get all your Mathematica input (functions, formulas, commands you use to answer questions) and the required output (evaluate all the necessary cells to produce/display your results, plots, etc.). Bring your project printout to class on 9/10/19. (While working on the project, you may want to use the help file posted on our web page for some examples.)

1. Use Mathematica to answer the following questions about the Lissajous figure given in Exercise 46 on page 573 of your text.

   (a) Plot the Lissajous figure. (Here you do not need a slider graph, just plot the parametric curve.)

   (b) Use Mathematica to compute the slopes of the two tangent lines to the curve at the origin (need to find at what t-value(s) both x and y equal to zero!).

   (c) Read about Mathematica function *Integrate* and use it to compute the length of the portion of the curve from $t = 0$ to $t = \pi$. Note that if *Integrate* does not give you the integral value, you may try *NIntegrate* (this gives a numerical approximation to the integral value), but before using *NIntegrate*, make sure that you set up the integral correctly and use *Integrate* with the proper syntax.

2. *Collision problem:*

   Two particles are moving in the xy-plane. For $0 \leq t \leq 2\pi$, particle one is at the point with coordinates $(3\sin(t), 2\cos(t))$ and particle two is at the point with coordinates $(3 + \cos(t), 1 + \sin(t))$ at time t.

   (a) Plot the two paths and count the intersection points. (Do not use a slider here.) Report the number of points in the text mode or as a comment.

(b) Use *Manipulate* to make a slider graph to demonstrate how many of the intersection points are collision points. Report the number of the collision points in the text mode or as a comment.

3. Use Mathematica function *PolarPlot* to graph all three curves in Exercise 30 on page 581 of your text and answer the question. You *do not have* to confirm your results algebraically.