## AA 218 - Homework 2

## Spring 2020

## Date due: Tuesday April 21

Read Chapter 2 and Chapter 3, sections 3.1 to 3.6. Feel free to use Mathematica or Matlab to help you solve any of the problems.

1) Complete EXERCISES 2.2 and 2.6.

In each problem try to list the governing parameters of the problem and use the procedure for generating dimensionless parameters given in Chapter 2 <u>before</u> applying any physics. Give a physical interpretation of each of the parameters found in problem 2.6.

Then, as best you can, use some basic physics to help your analysis. Check the solution using the web if you wish. I have put a couple of papers in the resources folder on my website that discuss problems 2.2 and 2.6.

## 2) Complete EXERCISES 3.2 and 3.8

3) EXERCISE - The solution, z[x, y], of the nonlinear first order PDE

$$(y+z)\frac{\partial z}{\partial x} + (x+z)\frac{\partial z}{\partial y} = x+y$$

is described in Example 3.3 page 71. Follow the steps and confirm the solution (3.91)

$$\frac{x-y}{x-z} = G\left[(x+y+z)(x-y)^2\right]$$

by direct substitution, where G is an arbitrary differentiable function.

4) <u>Be sure to submit your project proposal.</u> I am very open to your suggestions; it could be a problem derived from your research, or some other area of interest you might have from finance, biology, physics, chemistry, control theory, the grid, etc, Symmetry methods can be applied to virtually any field. This does not mean you have to solve some very complex problem. Your project might be exposition of an example from the literature where symmetry methods are applied. It could be something of current interest, such as say, the problem of viral spread or the problem of maintaining a supply chain in the face of disruption, etc. Some suggestions.

1) Describe/compare the various models and assumptions used to predict viral spread in the current pandemic.

2) Discuss the application of symmetry methods to modern finance, including solutions of the Black-Scholes equation

3) Describe the influence of symmetry methods on the development of quantum theory.

4) How are symmetry methods used in Cosmology?

5) How are symmetry methods used in turbulence modeling and in statistical theories of turbulence.