

# Mathematical Physics II

## PHYS 502

### Problem Set # 6

Distributed February 17, 2016

Due February 26, 2016

1. In 1963 E. N. Lorenz studied a drastic truncation of the Navier-Stokes equations that might describe atmospheric convective flows. The equations he studied are

$$\begin{aligned}\dot{x} &= -\sigma x + \sigma y \\ \dot{y} &= Rx - y - xz \\ \dot{z} &= -bz + xy\end{aligned}$$

He studied these equations for many values of the parameters  $R, \sigma, b$ . You will study them for just one set:  $(R, \sigma, b) = (28, 10, 8/3)$ .

- a. Find the fixed points (there are 3 real fixed points).
- b. Determine the stability of each fixed point.
- c. Integrate these equations until the transients die out, then plot  $x(t)$  vs.  $z(t)$ .
- d. Plot  $x(t)$  vs.  $t$  and  $z(t)$  vs.  $t$ . The plots in **c.** and **d.** should be ‘interesting’.
- e. Compute and plot the Fourier Transform of  $x(t)$ .
- f. Plot the power spectrum of  $x(t)$ .

**Important:** You must know the conventions used in the FT or (preferably) FFT routine you use to understand and manipulate the output of these routines. If this information is not available, run these codes on a data set for which you know what the FT and power spectrum look like.