PHYS 580 Homework 2 - due Wed Sep 25, 2019, in class

All questions are worth 10 points, irrespectively of complexity or length. Please submit all your solutions on paper, and make sure to

a) discuss the physics and your results, as appropriate and/or directed

b) include graphical output to illustrate the results

c) include the source codes of your programs (at least the critical parts thereof)

d) describe briefly what your program does, and how it does it (algorithm)

e) state the nature of the numerical approximation used, and demonstrate how you know that the particular approximation (with the parameters you used) is adequate for the problem you used it for.

1) For the driven, nonlinear pendulum, investigate how the Poincare section depends on the strength of the linear dissipation term. Use the same physics parameters as the calculation in Fig. 3.6 of the Giordano-Nakanishi book. First set $F_D = 0.5$, $q = 0.5$, which puts you in the periodic regime, and then vary q to see how the Poincare section changes. Next, repeat the same from a starting point $F_D = 1.2$, $q = 0.5$ in the chaotic regime. In both cases, keep all other physics parameters fixed as you vary q.

2) Problem 3.4 (p.53).

3) Problem 3.5 (p.54). Also check how well the periods computed in Problem 2 agree with the analytic results, and discuss whether the difference you find is within the expected accuracy of the numerical calculation.
Note: there is a typo in (3.9). On the right hand side, x^α should correctly read $\mathrm{sgn}(x)|x|^\alpha$, where the sign function is

$$\mathrm{sgn}(x) = \begin{cases} +1, & \text{if } x > 0 \\ 0, & \text{if } x = 0 \\ -1, & \text{if } x < 0 \end{cases}$$

as usual. This way the equations of motion make sense for arbitrary $\alpha > 0$ (instead of only positive odd integers).

4) Problem 3.13 (p.65).

5) Problem 3.20 (p.70).

There are quite a few misprints and other errors in the text, which might be relevant to your homework. So make sure to check the errata page at:
`http://www.physics.purdue.edu/~hisao/book/www/errata.html`