

## Homework #14

Due: Jan 20, 2021

1. Consider the periodically vertically forced and damped pendulum equation:

$$\frac{dq}{dt} = p, \quad \frac{dp}{dt} = -\sin(q)(1 + \varepsilon \sin(\omega t)) - \delta p \quad (1)$$

- (a) Compute the Melnikov function and explain your results in terms of the stable and unstable manifolds structure (it is sufficient to find the Melnikov function up to quadratures).
- (b) Show geometrically (by schematic drawing) how a Smale horseshoe arises in such a system.
- (c) Integrate numerically the equations and present your results by projections to various spaces and by looking at the time  $T$  Poincare map. Explain your results.