# BM5063 Systems Medicine

## Problem Set 1

### Instructions

1. You are not expected to submit answers to these problems

### Questions

1. Analyze the following systems, identify FPs, and their stability properties using the phase-plane method and by the method of perturbation

   (a) $\dot{x} = -x$

   (b) $\dot{x} = -x \pm x^2$

   (c) $\dot{x} = -x \pm x^3$

   (d) $\dot{x} = \dfrac{3y^2}{1+y^2} - x,\ \dot{y} = \dfrac{3x^2}{1+x^2} - y$

   (e) $\dot{x} = \dfrac{4}{1+y^2} - x,\ \dot{y} = \dfrac{4}{1+x^2} - y$

   (f) $\dot{x} = x - xy,\ \dot{y} = 2xy - y$

2. Write `Python` code to solve the systems described in the problem above.

3. Cells have clocks that track the time of day called circadian clocks. Beta cells secrete more insulin for a given level of glucose during the day than during the night. Modify the model discussed in the class to reflect this effect.

   - What does the new model predict for steady-state glucose and insulin during the day and night?
   - Is it unhealthy to eat big late-night meals?