

APh161: Physical Biology of the Cell
Homework 5, Part A
Due Date: Monday March 9, 2009

“A traveler who refuses to pass over a bridge until he has personally tested the soundness of every part of it is not likely to go far; something must be risked, even in mathematics.” – Horace Lamb

Reading:

Read section 19.3 of Physical Biology of the Cell (PBOC).

1. A Synthetic Transcriptional Oscillator.

(a) Rederive with clear pedagogical explanations the dynamical equations for the repressilator given in section 19.3.3 of PBoC and derive these equations in their dimensionless form.

(b) Reproduce the CORRECTED VERSION of fig. 19.31 for repressilator posted on the website. You need to do this numerically either using Matlab or Mathematica or some other numerical technique.

(c) EXTRA CREDIT (but worth 20% of the grade for this homework). Reproduce the derivations in section 19.3.3 of PBoC starting where you left off at the end of part (a) and culminating in eqn. 19.67. This means that you need to explain the linear stability analysis that follows equation 19.46. I have instructed the TAs to not even bother looking at your solution if you do not explain in a clear, pedagogical fashion what is going on in the derivation. NOTE: there is a mistake in eqn. 19.52—there should be an m^{n-1} in the numerator instead of just an m . The correct equation is:

$$X = -\frac{\alpha n m^{n-1}}{(1 + m^n)^2} \quad (1)$$