

**Math 430 and Math 635: Analytical and Computational
Neuroscience
Fall 2001, Prof. V. Booth
Homework 4, Due Wednesday, Oct 10, 2001**

1. In the model of the passive membrane equation, change the applied current stimulus to be a sinusoid with amplitude $1 \mu\text{A}/\text{cm}^2$ and frequency that varies from 1 Hz to 1000 Hz. In the XPP file *passive.ode*, make the change $f(t)=\sin(2\pi t/\text{per})$ where *per* is the period of the sinusoid defined as a new parameter in the file. Remember that Hz=cycles/sec and time *t* in the model is in msec. Also, add the following lines to the end of the file *passive.ode* before the line that contains *done*:

```
@ total=2000,noutput=10,xlo=0,xhi=2000,ylo=-100,yhi=-40
```

Plot the amplitude of the membrane potential oscillations versus the log of frequency. You should see a decrease in the amplitude as frequency increases. This characteristic of passive neural membrane is called “low-pass filtering”.

2. For the Hodgkin-Huxley model, produce a frequency versus injected current (f-I) plot. You can use XPP and download the ode file *hh.ode* from the class website. Use an applied current range from 0 to a value that the model neuron does not spike anymore. For each run, measure the frequency at the end of the simulation when spiking has become steady. If the neuron does not repetitively spike, consider the frequency to be zero.