Math 450H
Homework III: Due 11/3/05
Prof. Bukiet
Topic: Basic Math Modeling of Spring-Mass Systems

1. Measure the spring constant of one of the springs in the capstone lab using several weights and employing the formula (Hooke's Law) $F = -kx$. Is the spring linear? Find a best fit line (F vs. x) for the data (Use at least 4 different masses). Give the results for k in Newtons/meter. Also, find the "best" value of k if the "best" line is constrained to go through the origin. Show the derivation for your least squares formulas. For comparison, calculate the spring constant by using the apparatus in the lab to measure the frequency of oscillations (Use the same masses). Discuss any discrepancies in the results.

2. Consider overdamped spring-mass system as explained in the class.

Show that the mass either decays to its equilibrium position (without passing through the equilibrium position), or that the mass shoots past its equilibrium position exactly once before returning monotonically toward its equilibrium position.

3. This problem is problem 9.4 of the text.

Suppose that a mass m were attached to two springs in parallel. See figure p. 27.

(a). What position of the mass is the equilibrium position?

(b). Show that the mass executes simple harmonic motion around the equilibrium position.

(c). What is the period of oscillation?

(d). If the 2 springs were replaced by just one spring but with different spring constant and resting length, what should the new spring constant and length be to have the equivalent motion as the original 2 spring system?