4) Mathematica take home section.
Due by email to: musumeci@physics.ucla.edu by 6 pm on Thursday November 29th.

a) Solve with Mathematica the equation of motion for three masses of mass m attached with non linear springs. Each of the spring can be described by a potential energy

$$V = \frac{1}{2}kx^2 + bx^4$$

where x is the distance from the equilibrium position.

b) In the linear approximation, find the characteristic eigenmodes and eigenfrequencies and verify that the Mathematica solutions yields the same motion if you set b = 0.

c) Go back to the non linear case (i.e. b > 0). Analyze the case where for small displacement the system oscillates in the first normal mode. If one increases the initial displacement the system shows its not linear character and the oscillations cannot be described by a single frequency. Compare the solutions found solving the equations of motion and the one from the linearized system. What can you say about the coupling in the non-linear case?

(In order to solve numerically you need to assign values to the physical constants of the problem. For example m = 1 kg, k = 1 N/m and b = 1 N/m^3)