Problem 4. [*10 points*]

A particle of mass m and electric charge q is situated in an alternating electric field along the x-axis, $E = E_0\, cos(\omega t)$. The particle also experiences a force proportional to the third derivative of the x-position, $F_\alpha = \alpha x'''$ (which is due to the recoil of the particle from the radiation it emits when accelerated). Find the amplitude and phase (relative to the electric field) of the oscillation of the particle in the steady state. This model gives and approximate description of a charged particle, which scatters radiation.

Problem 5. [*10 points*]

A blob of putty of mass m falls from height h onto a massless platform, which is supported by a spring of constant k. A dashpot provides a damping force $F = -\gamma x'$, where $\gamma > 0$. Take the platform to be initially at $x = 0$. The putty instantaneously hits and sticks on the platform.

a) What is the equation of motion of the platform?

b) Find the most general solution to the previous differential equation taking into account the initial conditions. Hint: start measuring the time from the moment the putty hits the platform to figure out the initial conditions of the platform.

c) Sketch the displacement of the platform as a function of time for the critically damped case.

d) Determine the amount of damping i.e. the value of gamma, such that under a given initial condition the platform settles to its final position at rest the most rapidly.