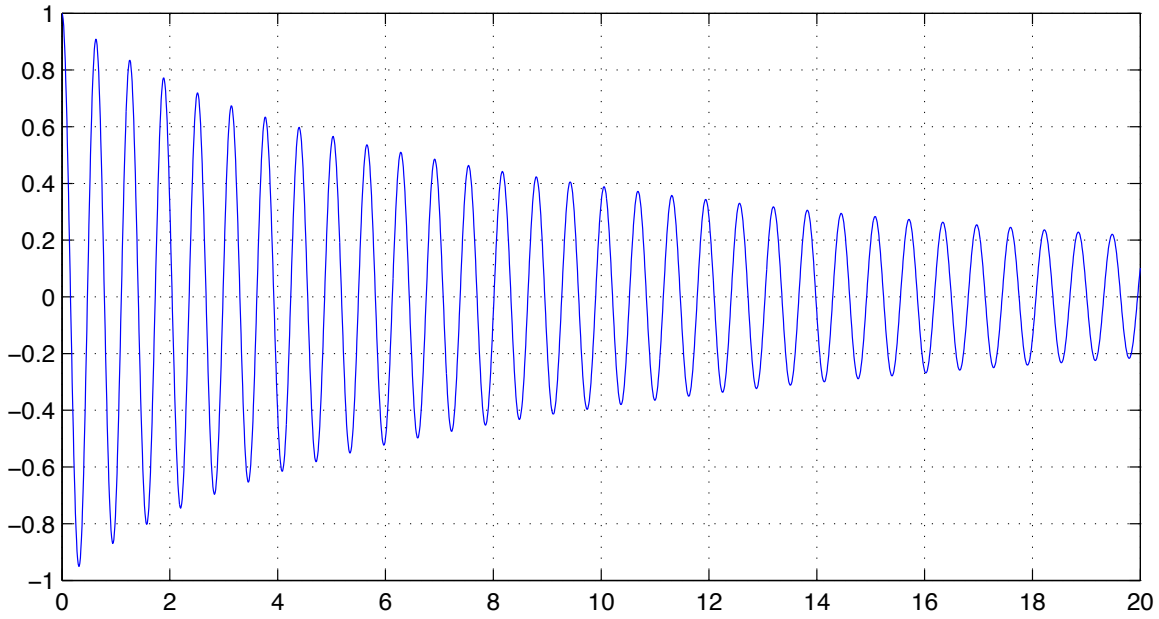
ME 460/660, Mechanical Vibration — Test 1, Fall 2009

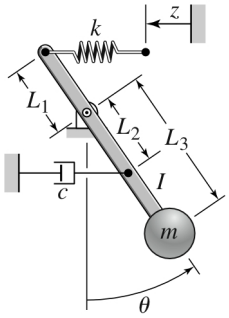
Closed book, closed notes. Test booklets will be provided. Formula sheet must be turned in with the exam. Formula sheet must be exactly the same as that posted on the web site. Calculators allowed. Problem 4 is required for graduate students.

1. Find the forced response (particular solution) of $\ddot{x} + .1\dot{x} + 1000x = 5\sin\omega t$ for $\omega = 1$ Hz, 5 Hz, 10 Hz, and 100 Hz.

2. Is the damping in the system whose response is shown below purely viscous? If not, what additional form of damping appears to be present?



3. Derive the equation(s?) of motion for the following system. The input $z(t) = Z\sin\omega t$. When $z = 0$ and $\theta = 0$, the spring is unstretched. *You were not asked to solve them, so don't!*



4. *Grad student/bonus:* Determine the natural frequencies and mode shapes for a free-clamped (fixed on the right end) circular cross section extension rod. The equation of motion of a rod is $\left(\frac{E}{\rho}\right)\frac{\partial^2 w(x,t)}{\partial x^2} = \frac{\partial^2 w(x,t)}{\partial t^2}$. (20% of other points)