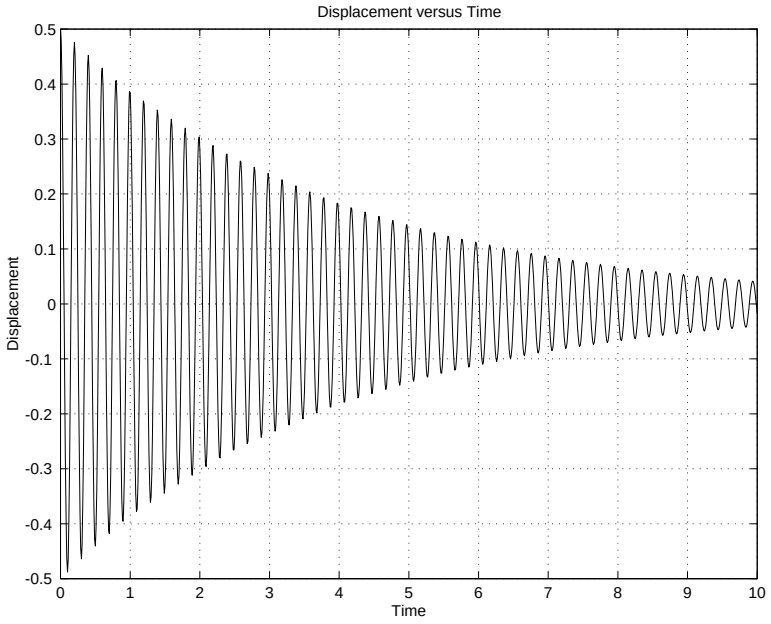
ME 460/660, Mechanical Vibration — Midterm, Fall 2007

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. Problem 4 is required for graduate students.

1. Given $k = 100$ N/m, find m and c for the system with the following free response:



2. A linear system is governed by the following equation of motion:

$$10\ddot{x} + 3\dot{x} + 10000x = 20y + 0.1\dot{y}$$

where $y(t) = Y\sin(\omega_b t)$.

   (a) Sketch the FRF $\frac{X(j\omega)}{Y(j\omega)}$ for $0 < \frac{\omega_b}{\omega_n} < 3$. Use decibels ($20\log_{10}$) for the magnitude. *label limit values in decibels!!!*

   (b) Write $x(t)$ if $y(t) = 2\sin(31.416t)$.

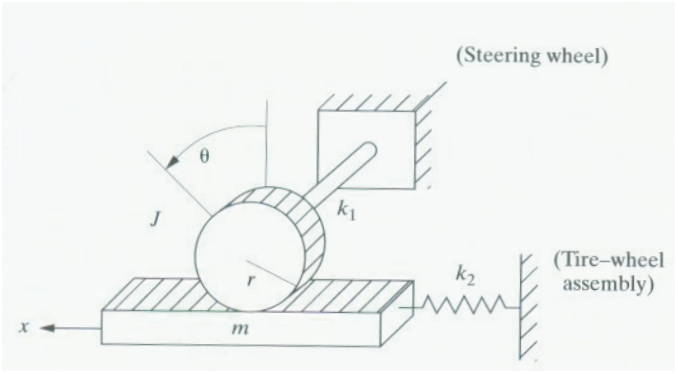
   (c) Fill in the following table **in your exam book** (*beware of units!*):

Y (m)	f_b (Hz)	$\lvert X\rvert$ (m)	$\measuredangle X$ (deg)
10	3		
2	5		
1	10		

3. For the system following

   (a) determine the equation of motion in terms of θ.

   (b) determine the natural frequency.



4. *Grad student/bonus:* Determine the natural frequencies and mode shapes for a clamped-clamped bar. The equation of motion of a torsion rod is $\left(\frac{G}{\rho}\right)\frac{\partial^2 w(x,t)}{\partial x^2} = \frac{\partial^2 w(x,t)}{\partial t^2}$. (20% of other points)