ME 460/660, Mechanical Vibration Midterm, Fall 2005

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 5 is required for graduate students.

1. Exposure to 18 g (18 times gravity) acceleration causes permanent brain damage. At 20 Hz, what is the maximum allowable velocity amplitude to ensure a safety factor of 1.1? What is the maximum allowable displacement? What is your sense of the ramifications of submitting a human to these conditions?

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

$$m\ddot{x} + c\dot{x} + kx = c\dot{y}$$

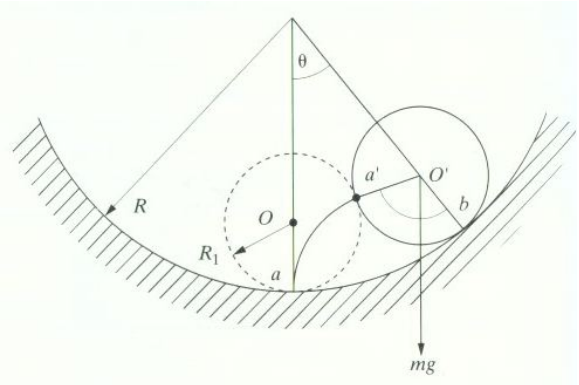
   where $y(t)$ is a harmonic excitation. Sketch the amplitude of the frequency response function for no, low, and high damping. What are its values for a driving frequency near zero, approaching infinity, and near resonance.

3. What is the log decrement value, δ, of a single degree of freedom system with a damping ratio of 0.015. Sketch the response, with best reasonable accuracy of the decay envelope, and illustrate how this is apparent in a response.

4. For the system shown below

   (a) determine the equation of motion in terms of the displacement x.

   (b) determine the natural frequency.



5. *Grad student/bonus* Determine the natural frequencies and mode shapes for a clamped-clamped bar. The equation of motion of a bar 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)