ME 460/660, Mechanical Vibration — Exam 1, Fall 2003

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.

1. What does a dashpot (damper) do with energy? Where does the energy go (give two examples). (15 points)

2. Exposure to 18 g (18 times gravity) acceleration causes permanent brain damage. At 1000 Hz, what is the maximum allowable displacement amplitude to ensure a safety factor of 10? (15 points)

3. The mass of a SDOF system is measure to be 5 kg, while the natural frequency, ω, is found to be 10 rad/s. It is observed that during free vibration the amplitude decays to 0.25 of its initial value after five cycles. Calculate the viscous damping coefficient c. (25 points)

4. Derive the equation of motion of the system shown below. The pulley is assumed to have frictionless bearings, but it *does have a significant mass moment of inertia*, J. (25 points)

5. *Grad student/bonus* Determine the natural frequencies and mode shapes for a clamped-clamped (fixed-fixed boundary conditions) 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)