ME 460/660, Mechanical Vibration   Exam 1, Fall 1999

Closed book, closed notes. Use one $8\frac{1}{2} \times 11$ formula sheet, front and back, no examples, derivations, or solutions. **The formula sheet must be turned in with the exam or 25 points will be deducted from your score.** Test booklets will be provided.

1. On what law is the energy method based? When is this law violated? Give a physical explanation, *not* "When such and such law fails". (10 points)

2. A device is limited to an acceleration of 100 m/s^2 and a displacement of 1 cm. What is the maximum possible velocity under these restrictions and at what frequency is it possible? (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

   (a) using Newton's Laws (25 points)

   (b) using the Energy Method (25 points)

5. *Grad student/bonus* Determine the natural frequencies and mode shapes for a free-free 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)