

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. What do the following devices do with energy in a vibrating system? If a device stores energy, what form does it store energy in? (15 points)
 - (a) Spring
 - (b) Dashpot
 - (c) Mass
2. Obtain the particular solution (forced response) for the following equation of motion: $100\ddot{x} + 5\dot{x} + 10000x = 5e^{50jt}$. (15 points)
3. Prolonged exposure to 5×10^{-4} g floor oscillation (or above) is deemed intolerable for comfort. At 7 Hz, what displacement amplitude would cause discomfort? (15 points)
4. Derive the equation of motion of the system shown below. (25 points)

Figure P2.48, page 117, Di-marogonas: Place the figure so that it covers this text. Center it between the right and left sides of the page, and make sure that it is not rotated. Please make sure to include the variable definitions part of the figure. Do not include the figure label.

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