ME 460/660 Final Exam, Fall 94

Please **read** the problems very carefully. Each problem is worth 20 points.

1) Use Laplace Transforms to find the response of the a single degree of freedom system to initial conditions of $x_o = 0$ and $v_o = 0$. Use the following Laplace transforms:

$$\frac{\omega_d}{s^2 + 2\varsigma\omega s + \omega^2} = L\{e^{-\varsigma\omega t}\sin(\omega_d t)\}$$

$$\frac{s + \varsigma\omega}{s^2 + 2\varsigma\omega s + \omega^2} = L\{e^{-\varsigma\omega t}\cos(\omega_d t)\}$$

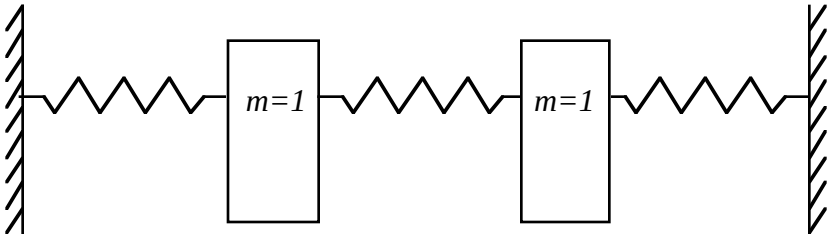
$$L\{\dot{x}(t)\} = sX(s) - x(0)$$

$$L\{\ddot{x}(t)\} = s^2X(s) - sx(0) - v(0)$$

2) The 30 kg "Iron Bird" in the Vibrations lab must be supported such that only 10^{-4} of a sinusoidal force acting at 200 Hz can be transmitted to the ceiling of the lab. Design a suspension system to accomplish this. Assume that the minimum damping ratio that can be obtained is .025. (This criteria has been exceeded in reality).

3) A dual speed motor is mounted on a table. The natural frequencies of the table are 167.8 rad/s and 321.9 rad/sec. The motor is operated at 1000 and 2000 rpm. The mass of the table/compressor is 75 kg. Design a cost-effective method to minimize the shaking of the table for both operating speeds. Sketch how you would attach the vibration absorbers to the table. Is there anytime during the operation of the motor that the vibration suppression system will not meet the design specifications? If so, when?

4) Design a support system for a two degree of freedom system such that the natural frequencies are 2 and 4 rad/s. The masses are 1 kg each.



5) Derive the equations of motion for the following system ($J = (1/2)mr^2$).