ME 460/660, Mechanical Vibration — Exam 2, Fall 1998

Closed book, closed notes. Use one $8\frac{1}{2} \times 11$ formula sheet, front and back. Test books will be provided.

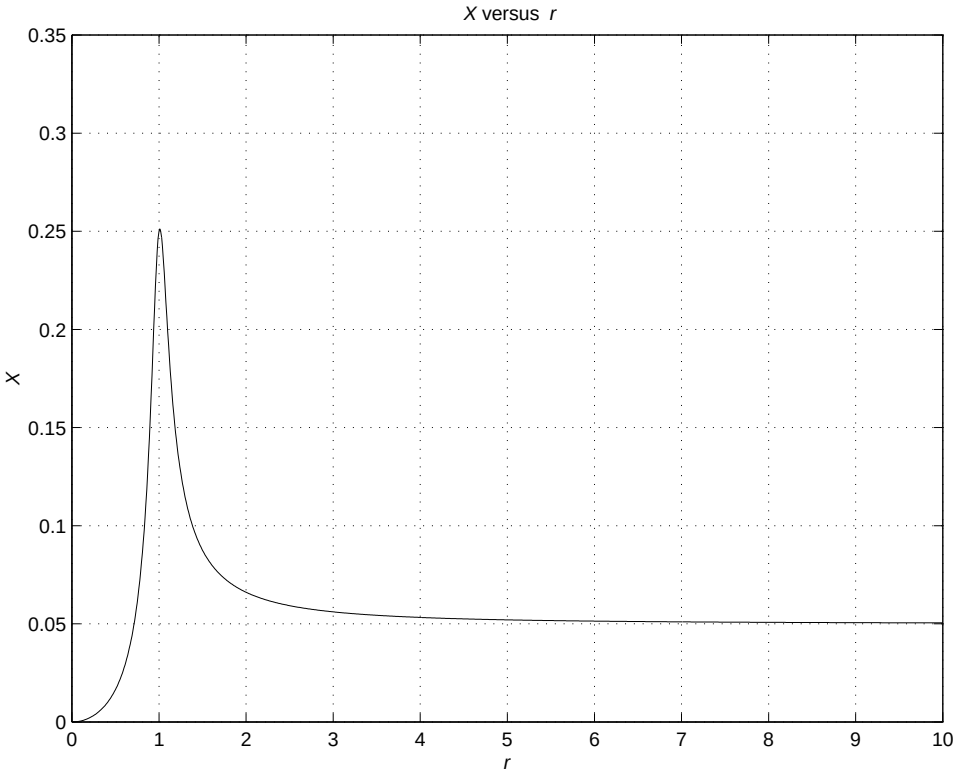
Problems are 20 points each. 10 points for graduate/bonus.

1. A vehicle modeled as a mass-damper-spring system is traveling on a wavy road at the constant velocity v, as shown below. Derive the system response in terms of the unknown values m, c, k, L, v, and A.

Figure 3.23 goes here (page 136)
Please make 17 copies

2. Use the convolution integral to find the forced response of the following system for $t > 10^{-4}$: $m = 1$ kg, $c = 0$ kg s, $k = 100$ N/m, $F(t) = 1$ for $0 < t < 10^{-4}$, $F(t) = 0$ for $10^{-4} < t < \infty$. Assume zero initial conditions.

3. Identify the natural frequency, damping ratio, and rotating unbalance ($m_0 e$) for machine whose **un**normalized frequency response is shown below. All units are in standard SI units (mks). The mass is 1000 kg, and resonance occurs when the machine is run at 2000 RPM.



4. Graduate students/bonus: Determine the mode shapes and natural frequencies of a string with the properties A, τ, ρ (mass per unit length), and L. The equation of motion of the string is $\frac{\tau}{\rho}\frac{\partial^2 w(x,t)}{\partial x^2} = \frac{\partial^2 w(x,t)}{\partial t^2}$. The boundary conditions are $w(0,t) = 0$, and $w(L,t) = 0$.