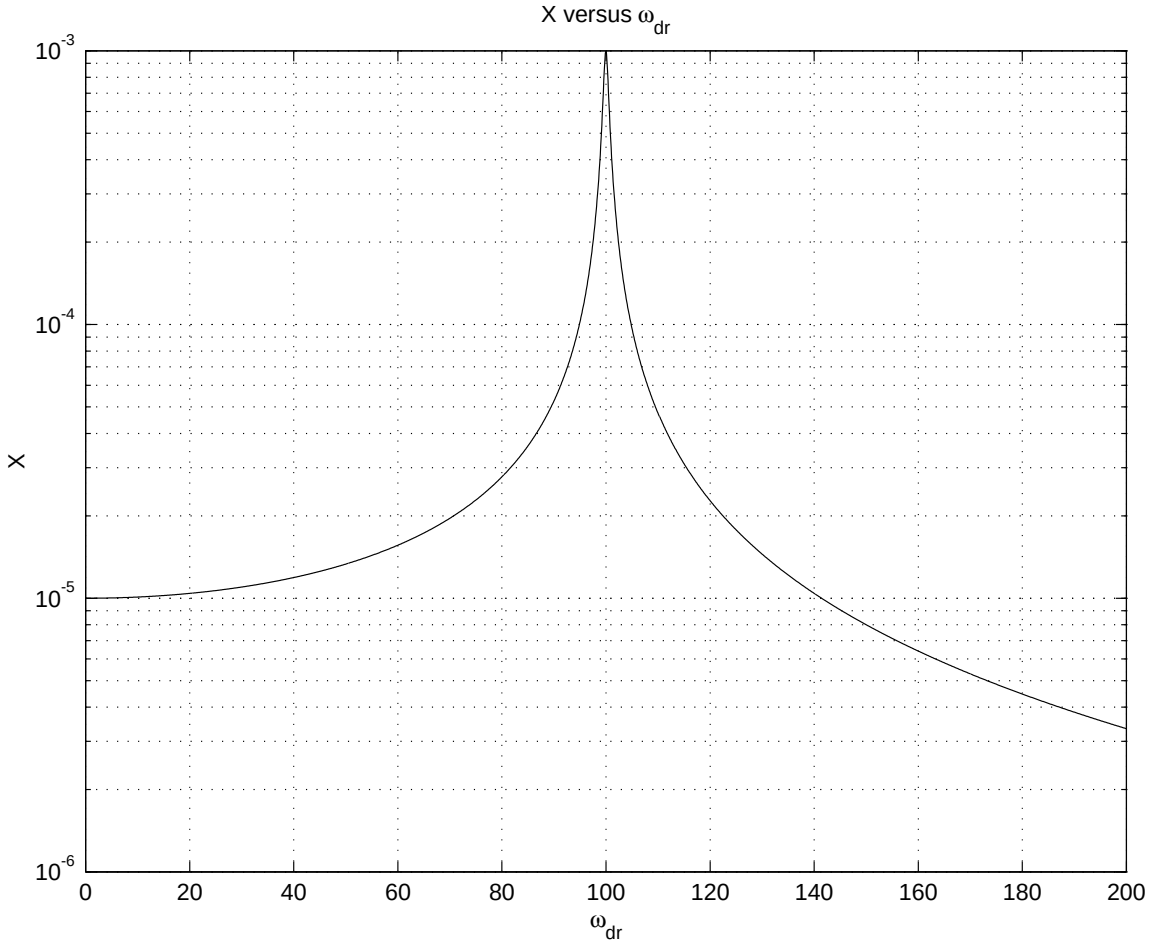
ME 460/660, Mechanical Vibration — Exam 2, Spring 2000

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

Problems are 10 points each. Problem 4 is required for graduate students.

1. Determine the response of a single degree of freedom undamped system to a ramp excitation $F(t) = F_0 t$.

2. Determine the mass, m, damping *coefficient*, c, and stiffness, k, for the system with the transfer function $H(j\omega) = X(j\omega)/F(j\omega)$, shown below.



3. A vibrating mass of 300 kg, mounted on a massless support by a spring of stiffness 40,000 N/m and a damper of unknown damping coefficient, is observed to vibrate with a 100-mm amplitude at resonance while the support vibration has a maximum amplitude of only 2.5 mm.

(a) Calculate the damping coefficient approximately.

(b) Calculate the force on the base.

4. Graduate students/bonus: Determine the mode shapes and natural frequencies of a bar with constant circular cross section in torsional vibration with clamped-clamped boundary conditions. The equation of motion is given by $GJ_1 \frac{\partial^2 \theta(x,t)}{\partial x^2} = \rho J \frac{\partial^2 \theta(x,t)}{\partial t^2}$.