ME 460/660, Mechanical Vibration — Exam 2, Fall 2001

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, bonus for undergraduates

1. Derive the equation of motion for the following system where $y(t) = Y \sin(\omega_b t)$:

2. Find the response of the the system governed by the following equation of motion. Sketch its nondimensionalized magnitude and phase versus r for multiple values of ζ, and label the values in simplest terms at $r = 0$, $r = 1$, and $r = \infty$.

$$m\ddot{x} + c\dot{x} + kx = c\dot{y}$$

   where $y(t) = Y \cos(\omega_b t)$.

3. A Coulomb damped SDOF system is released from rest with a displacement of 10 cm. If $m = 5$ kg, $k = 1000$ N/m, determine the ensuing motion for

   (a) $\mu_s = \mu_k = .1$,

   (b) $\mu_s = \mu_k = .3$

4. Find the natural frequency of a shaft (torsion) if it is clamped at $x = 0$ and if a disk with $J_0 = 10$ kg/m^2 is attached to the other end of the shaft ($x = l$). Assume $l = 0.5$ m, $J = 5$ m ^{4}, $G = 2.5 \times 10^9$ Pa, $\rho = 2700$ kg/m^3.