ME 460/660, Mechanical Vibration Final Exam, Spring 1997

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

1. Define the following variables and state which ones are parameters of the system and which ones are parameters of the excitation.

   (a) ω

   (b) ω_{dr}

   (c) ω_b

   (d) ω_d

   (e) c_{eq}

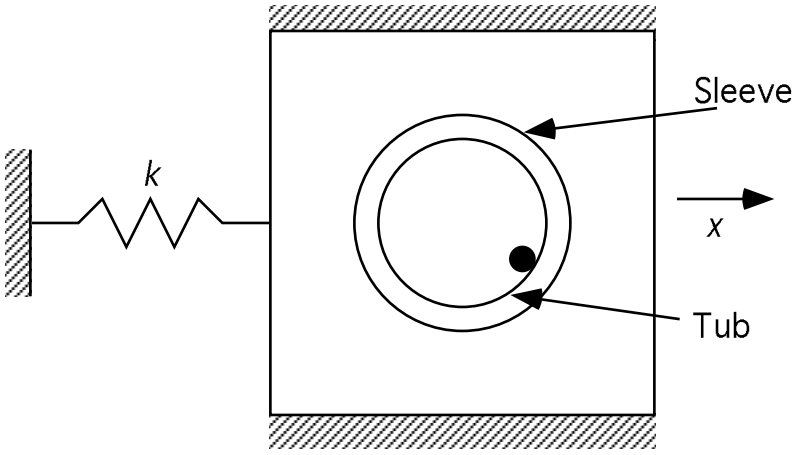
   (f) ω_T

   (g) ω_r

   (h) ζ

2. The mass of a SDOF system is measure to be 5 kg, while the stiffness is found to be 5000 N/m. It is observed that during free vibration the amplitude decays to 0.25 of its initial value after five cycles. Calculate the viscous damping coefficient c.

3. The figure below illustrates the top view of a top loading washing machine. The rotational speed of the drum is $\omega = 30$ rad/s and the radius of the drum is $r = .3$ m. Assume that all of the wet clothes have gathered into a ball of mass 6 kg (approximated by a point mass at the edge of the tub). The drum rotated within a non-rotating sleeve. The sleeve is rigidly attached to the outer assembly. The total assembly has a mass of 3 kg (excepting the clothes). The assembly is rigidly restrained in the y direction, and is restrained in the x direction by a spring of stiffness $k = 500$ N/m. Determine the resulting force on the ground due to the motion of the tub.



4. A MDOF system is defined by the matrices M and K shown below. For this system, obtain the natural frequencies, the mode shapes, and the matrices P and S.

$$M = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, \qquad K = \begin{bmatrix} 6 & -2 \\ -2 & 6 \end{bmatrix}$$

5. Derive the equations of motion for the following system. (*Hint, use Lagrange's equations*)