13.013 Problem Set 12 Option

1. An air conditioner on the roof of your house has a blower with a rotation ra te of 1200 RPM. Due to a small imbalance the AC causes annoying vibration in ht e house. You must devise a vibration isolation system to reduce the dynamic ver tical force being applied to the floor. Design a spring support that will reduc e by a factor of 10 the force transmitted to the floor at 1200 RPM. Assume 5% damping is required to prevent excessive vibration during startup. What is the r atio ω/ω_n that is required? what is the natural frequency ω_n and w hat is the static deflection of the AC resting on the isolation mounts? See fig ure below.

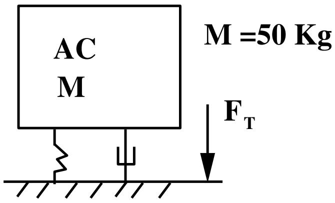

Figure 1:

2. In problem 8.6 from Problem Set 10 apply a harmonic force at $\Omega = R$.

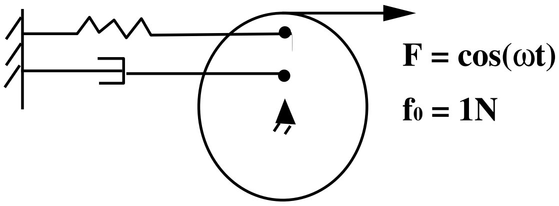

Figure 2:

Find the steady state response amplitude and phase angle for $\theta(t) = \theta_0 \cos(\omega t - \phi)$ for $\omega = \omega_n$ *and* $\omega = 5\omega_n$

3. In problem 2 above compute the average dissipated power for both cases. In rotational coordinates:

$\pi(t) = Torque \cdot$ Angular velocity $= \tau\dot{\theta}$

Hint: Find the forms analogous to $<\pi>_t = \frac{f_0^2 \sin^2\phi}{2R} = \frac{R\omega^2 X_0^2}{2}$