This Week in SP351:2001: Homework, etc.

Homework must be submitted stapled in assignment groupings.

Always attempt to complete the readings before class. You are responsible for reading 10 pages past the current lecture. You may not understand the material completely, but you must read it prior to lecture.

** Problems to submit on the date listed: **

Week of 27 Sep

Monday:

Wednesday **Read the eigenvalue handout**

***** Be prepared to receive HANDOUTS !**

Friday:

Week of 04 Oct

Monday **EV1, EV5, A7.**

B: => Boas Problem EV: => Eigenvalue

A: => Auxiliary Problem - statement on this page !

Hints

A7.) Resonant systems are often analyzed using complex methods. A common result has the form. $A e^{-i\theta} = \dfrac{f_o}{\left[\left(\omega_0^2 - \omega^2\right) + 2i\gamma\omega\right]} = \dfrac{\left[\left(\omega_0^2 - \omega^2\right) - 2i\gamma\omega\right] f_o}{\left[\left(\omega_0^2 - \omega^2\right)^2 + \left(2\gamma\omega\right)^2\right]}$ where all values are real except for, of course, *i*. The factor *A* is the amplitude of the displacement due to an applied sinusoidally varying force $F(t) = F_0 \cos(\omega t)$ where $m f_0 = F_0$. The symbol θ represents the phase by which the response, the displacement, lags behind the driving source. The frequency ω is a variable running from 0 to infinity. The ω_0 ($=\sqrt{k/m}$) and all other symbols on the right-hand side represent constants. Find the values of $A(\omega)$ and $\theta(\omega)$ for $\omega = 0$, ω_0 and $\omega >> \omega_0$. Prepare sketches of $A(\omega)$ and **- θ(ω) [note the minus!]** for $0 < \omega_0 < 2\,\omega_0$. To facilitate the plot, define $Q = \omega_0 / 2\gamma$ and $u = \omega/\omega_0$.

$$A(\omega)\; e^{-i\theta(\omega)} = \frac{\left[\left(\omega_0^2 - \omega^2\right) - i\omega_0\omega / Q\right] f_o}{\left[\left(\omega_0^2 - \omega^2\right)^2 + \left(\omega_0\omega / Q\right)^2\right]} = \frac{\left(F_0/k\right)\, e^{-i\tan^{-1}\left(\frac{u}{Q\left(1-u^2\right)}\right)}}{\sqrt{\left(1-u^2\right)^2 + \left(u/Q\right)^2}}$$

Q is called the *quality factor* of an oscillator. When damping factor γ is small, the *Q* is large leading to dramatic amplitude enhancements (resonance) for ω near the natural oscillator frequency ω_0. Sketch for $Q = 2$ and 20 and $0<u<3$. In each case, find the ratio of $A(\omega = \omega_0)$ to $A(\omega = 0)$. What is $-\theta(\omega_0)$?

9/28/04