Supplemental Notes

There are some points mentioned in today's (September 11, 2002) lecture that may pertain to your work on the first problem set. Or maybe not - it's up to you, of course.

• The definition of the oscillator quality "Q" will vary with the user. Note that B&B give a definition motivated by energy considerations, while French uses a comparison of time scales. A definition that leads to $Q = \omega_0/(\pi\gamma)$ is also based on time scales. The extra factor of π, which was made to "go away," really doesn't matter. An oscillator that is "high-Q" or "low-Q" will still be "high" or "low" regardless of the factor of π.

For practical purposes, the desired quantity is often $\log(Q)$, in which case the multiplicative factor of $1/\pi$ becomes an additive term, easily discarded. See for instance see B&B Table 1.2, Page 60. An extra factor of π won't change the entries appreciably, and the ratios of the respective Qs, which is the whole idea, won't change.

• For the driven, damped harmonic osicllator, with driving force $F_0 \cos\omega t = \Re\left[F_0\, e^{j\omega t}\right]$, a solution of the form $x = \Re\left[A\, e^{-j\delta}\, e^{j\omega t}\right]$. It may be tempting to compare this to the form for $Q(t)$ in parts d-f of Problem 1.1, and to set $\phi = -\delta$; don't do so. In the above, δ is the phase difference between the driving force and the output (position in this case). The phase ϕ is determined by the initial conditions, promised as the subject of Monday's lecture.

Also, you need not be told, I'm sure, that this δ is not the same as that in part 1.1f. In the above, the fancy $\Re$ is the fancy TEX character for "real part of." If you care greatly, the TEX command is `\Re`.

• In analyzing the response curve

$$A(\omega) = \frac{F_0/m}{\sqrt{(\omega_0^2 - \omega^2) + \omega^2\gamma^2}},$$

Prof. Wyslouch said that finding the value of ω that maximizes $A(\omega)$ is a good exercise. It is. Realistically, you're not likely to do extra problems, but if you're so inclined, go all the way and do the problem for the electrical equivalent, Problem 1.9 of B&B. (Part (a) is analogous to maximizing $A(\omega)$.) From the results, you should see that for certain values of the parameters, $A(\omega)$ might not have a maximum except at the origin. This would be a very low-Q system.