your name(s)____________________________

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Physics 321 Quiz #6- Wednesday/Friday Feb. 13/15

Work in groups of 6, open notes/book/internet/mouth

A particle of mass, $m = 100$ grams, moves in a harmonic oscillator where the fundamental frequency (no damping) is $f_0 = 2.0$ Hz. The damping rate is $\beta = b/2m = 3.0$ Hz. A transient external force of strength $F_0 = 50$ N is applied only for times between $t = -2.0$ and $t = 0$ s,

$$F = F_0\Theta(t+2)\Theta(-t).$$

Your group of 6 will divide into 3 pairs.

- Group A: Will calculate $x(t)$ using Green functions as described by Eq. (3.55), where the coefficients I_c and I_s are calculated by numerical integration.
- Group B: Will also use Eq. (3.55) but will calculate the integrals analytically. Group B will also analytically solve the answer by first finding the general solution in the region $-2 < t < 0$ by fitting the B.C. at $t = -2$, then using that solution to determine the coefficients of the general solution for $t > 0$ by matching the B.C. at $t = 0$.
- Group C: Will numerically solve the equations of motion similarly to what was described in Example 3.6.

Groups A and B will find the coefficients I_c and I_s, and compare to one another. Once they agree, the greater group will graph both the numerical solution of Group C and the result from Eq. (3.55) using the agreed-upon coefficients I_s and I_c. For credit, the greater group must show the plot, along with quoting the values for I_s and I_c.

Group B:

$$I_c = \mathrm{Re}\, I, \quad I_s = \mathrm{Im}\, I$$

$$I = F_0 \int_{-2}^{0} dt'\, e^{i\omega' t'} e^{\beta t'}$$

$$= \frac{F_0}{\beta + i\omega}\left\{1 - e^{-\beta\tau} e^{-i\omega'\tau}\right\} \qquad \tau \equiv 2$$

$$= \frac{F_0}{\beta^2+\omega^2}(\beta - i\omega)\left(1 - e^{-\beta\tau}\cos\omega'\tau + i e^{-\beta\tau}\sin\omega'\tau\right)$$

$$I_c = \frac{F_0}{\beta^2+\omega^2}\left\{\beta\left(1 - e^{-\beta\tau}\cos\omega'\tau\right) + \omega e^{-\beta\tau}\sin\omega'\tau\right\}$$

$$I_s = \frac{F_0}{\beta^2+\omega^2}\left\{-\omega\left(1 - e^{-\beta\tau}\cos\omega'\tau\right) + \beta e^{-\beta\tau}\sin\omega'\tau\right\}$$