1) $H(j\omega) = \dfrac{100\, j\omega}{(j\omega + .1)\left((j\omega)^2 + \underbrace{10}_{2\zeta\omega_n} j\omega + \underbrace{100}_{\omega_n^2}\right)}$

$\omega_n^2 = 100$

$\omega_n = 10$

$2\zeta\omega_n = 10$

$\zeta = \frac{1}{2}$

$$= \frac{10\, j\omega}{\left[\left(\frac{j\omega}{0.1}\right) + 1\right]\left[\left(\frac{j\omega}{10}\right)^2 + \left(\frac{j\omega}{10}\right) + 1\right]}$$

Break at 0.1

Break at 10.0

2) $+20$ dB/dec break at $\omega = 0.1$ (first order)

-40 dB/dec break at $\omega = 10$ (second order

20 dB peak implies a damping ratio of .05

$$H(j\omega) = \frac{1}{j\omega} \frac{\left(\frac{j\omega}{0.1} + 1\right)}{\left(\left(\frac{j\omega}{10}\right)^2 + .01\left(\frac{j\omega}{10}\right) + 1\right.}$$

$$= \frac{1000\,(j\omega + .1)}{(j\omega)^2 + 1.0\, j\omega + 100}$$

3) $x(t) = \cos t - \sin t$

$$\mathcal{L}[\sin t] = \frac{1}{s^2+1}$$

$$\frac{d}{dt}\sin t = \cos t$$

$$\mathcal{L}[\cos t] = \mathcal{L}\left[\frac{d}{dt}\sin t\right] = s\left[\frac{1}{s^2+1}\right] - \sin t\Big|_{t=0}$$

$$= \frac{s}{s^2+1}$$

$$\therefore \quad X(s) = \frac{s}{s^2+1} - \frac{1}{s^2+1} = \frac{s-1}{s^2+1} = \frac{s-1}{(s+j)(s-j)}$$