RW 15.10

$$\frac{\Omega_r(s)}{\Omega(s)} = H(s) = \frac{40000}{s^2+20s+40000}$$

$40000 = 0$

no zeros

$s^2+20s+40000=0$

$$p = \frac{-20 \pm \sqrt{20^2-4(40000)}}{2}$$

$$= \frac{-20 \pm \sqrt{400-160000}}{2}$$

$$= \frac{-20 \pm 399.5j}{2}$$

$p = -10 \pm 199.75j$

$p = -10+199.75j,\ -10-199.75j$

$$\Omega(t) = \Omega_o\left(1+\frac{1}{4}\sin(2\Omega_o t)+\frac{1}{8}\sin(4\Omega_o t)\right)$$

a) find $\Omega_r(t)$ when $\Omega_o = 50$ rad/s

$$H(s)\Big|_{s\to jw} = \frac{40\,000}{(jw)^2+20jw+40\,000}$$

$$= \frac{40000}{40000-w^2+20jw}\ \frac{40000-w^2-20jw}{40000-w^2-20jw}$$

$$= \frac{1.6\times10^9-4\times10^4w^2-8\times10^5jw}{(4\times10^4-w^2)^2+400w^2}$$

$|H(j0)| = 1$

$$H(j100) = \frac{1.2\times10^9-8\times10^7j}{9.04\times10^8} = 1.33-0.0885j$$

$$|H(j100)| = \sqrt{1.33^2+0.0885^2} = 1.33$$

$$\angle H(j100) = \tan^{-1}\left(\frac{-0.0885}{1.33}\right) = \tan^{-1}(-0.067) = -0.066$$

$$H(j200) = \frac{-1.6\times10^8j}{1.6\times10^7} = 10j$$

$|H(j200)| = 10$

$$\angle H(j100) = \tan^{-1}\left(\frac{-10}{0}\right) = \frac{-\pi}{2}$$

$$\Omega_r(t) = \Omega_o\left(|H(j0)| + \frac{|H(j100)|}{4}\sin(100t+\angle H(j100)) + \frac{|H(j200)|}{8}\sin(200t+\angle H(jw))\right)$$

$$= 50\left(1+\frac{1.33}{4}\sin(100t-0.066)+\frac{10}{8}\sin\left(200t-\frac{\pi}{2}\right)\right)$$