Prelab 10

1. a)

$$2\cos(w_1 t)\cos(w_2 t) = \frac{1}{2}\left(e^{iw_1 t} + e^{-iw_1 t}\right)\left(e^{iw_2 t} + e^{-iw_2 t}\right)$$

$$= \left(e^{iw_1 t} e^{iw_2 t} + e^{iw_1 t} e^{-iw_2 t} + e^{-iw_1 t} e^{iw_2 t} + e^{-iw_1 t} e^{-iw_2 t}\right)\frac{1}{2}$$

$$= \left(e^{it(w_1+w_2)} + e^{it(w_1-w_2)} + e^{it(w_2-w_1)} + e^{it(-w_1-w_2)}\right)\frac{1}{2}$$

$$= (\cos((w_1+w_2)t) + i\sin((w_1+w_2)t) + \cos((w_1-w_2)t) + i\sin((w_1-w_2)t)$$

$$+ \cos((w_2-w_1)t) + i\sin((w_2-w_1)t) + \cos((w_1-w_2)t) + i\sin((-w_1-w_2)t)$$

b) $V(t) = A\cos(w_0 t) + A\cos(4w_0 t)$

$$V(t) = a_0 + \sum_{i=1}^{\infty}\left(a_i\cos(w_i t) + b_i \sin(w_i t)\right)$$

$$a_0 = \frac{1}{T}\int_0^T A\cos(w_0 t) + A\cos(4w_0 t)\,dt \qquad T = \frac{2\pi}{w_0}$$

$$a_0 = 0$$

$$a_i = \frac{2}{T}\int_0^T \left(A\cos(w_0 t) + A\cos(4w_0 t)\right)\cos(w_0 t)\,dt$$

$$a_1 = A$$

$$a_2 = A$$

$$b_i = \frac{2}{T}\int_0^T \left(A\cos(w_0 t) + A\cos(4w_0 t)\right)\sin(w_i t)\,dt$$

$$b_1 = 0$$

$$b_4 = 0$$

$$\boxed{V(t) = A\cos(w_0 t) + A\cos(4w_0 t)}$$

b) continued

$V(t) = A\cos(\omega_0 t)\, A\cos(4\omega_0 t)$

$a_0 = \frac{1}{T}\int_0^T A\cos(\omega_0 t)\, A\cos(4\omega_0 t)\, dt \qquad T = \frac{2\pi}{\omega_0}$

$a_0 = 0$

$a_i = \frac{2}{T}\int_0^T A\cos(\omega_0 t)\, A\cos(4\omega_0 t)\cos(\omega_i t)\, dt$

$a_1 = 0$

$a_2 = 0$

$b_1 = 0$

$b_2 = 0$

c)

$V(t) = A\cos(\omega_0 t)$ when $0 < t < \frac{\pi}{\omega_0}$ else 0

$a_0 = \frac{\omega_0}{2\pi}\int_0^{\frac{\pi}{\omega_0}} A\cos(\omega_0 t)\, dt = \frac{\omega_0}{2\pi}\cdot A$

$a_1 = \frac{\omega_0}{\pi}\int_0^{\frac{\pi}{\omega_0}} A\cos(\omega_0 t)\cos(\omega_0 t)\, dt$

2, $\frac{f_0}{2\pi} = \omega_0 = \frac{1}{R\sqrt{C_1 C_2}}$ $\quad Q = \frac{1}{2}\sqrt{\frac{C_1}{C_2}}$

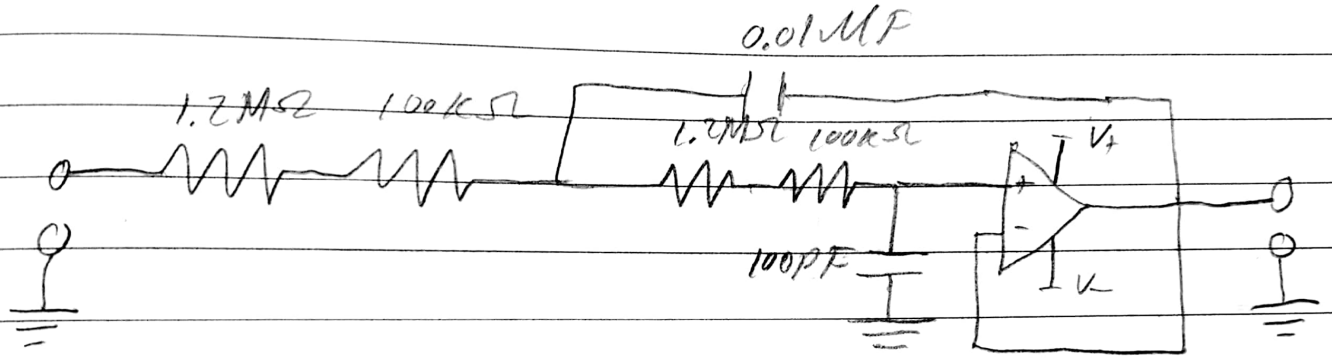
$R = \frac{1}{\frac{f_0}{2\pi}\cdot\sqrt{C_1 C_2}}$ $\quad 4Q^2 = \frac{C_1}{C_2}$

$4Q^2 C_2 = C_1$ $\quad C_2 = 100pF$

$4.25 \cdot 100pF = C_1$

$R = \frac{1}{\frac{4.8\times10^3}{2\pi}\sqrt{0.01\mu F \cdot 100pF}}$ $\quad 0.01\mu F = C_1$

$R \simeq 1,300,000\,\Omega$



5, a) i) $f_1 = 9KHz$, $f_2 = 11KHz$

ii) $f_1 = 9KHz$, $f_2 = 10KHz$, $f_3 = 11KHz$

b) i) $f_1 = 4KHz$, $f_2 = 6KHz$

ii) $f_1 = 4KHz$, $f_2 = 5KHz$, $f_3 = 6KHz$

c)