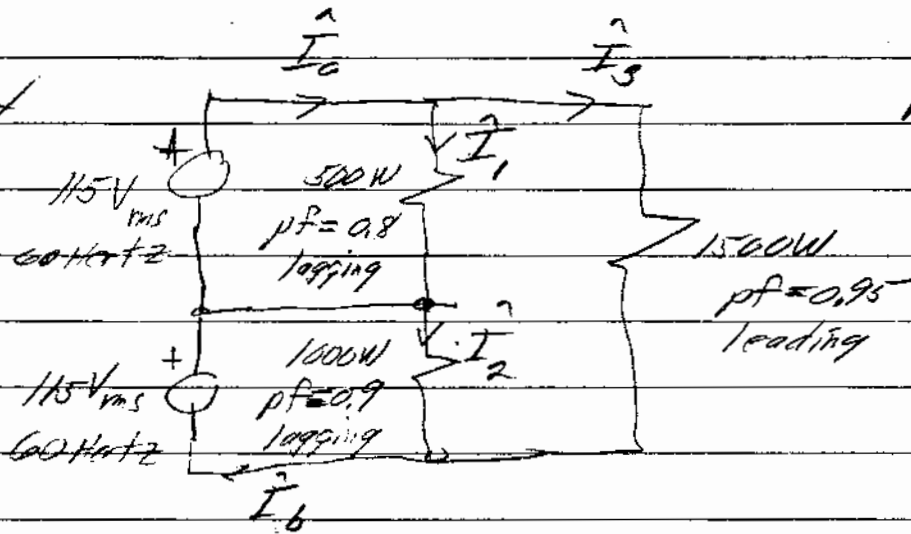


9.34



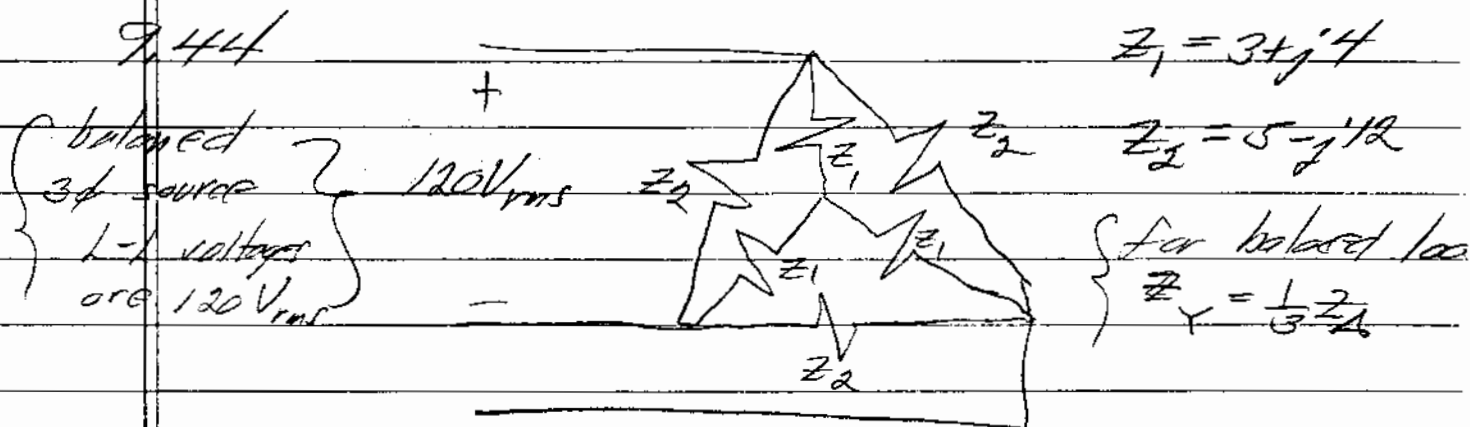
$$P = V_{rms} I_{rms} (\text{pf})$$

$$\hat{I}_1 = \frac{500}{115 \times 0.8} \angle^{-j \cos^{-1} 0.8} = 5.435 \angle^{-36.87^\circ} = 4.348 - j3.26$$

$$\hat{I}_2 = \frac{1000}{115 \times 0.9} \angle^{-j \cos^{-1} 0.9} = 9.66 \angle^{-25.84^\circ} = 8.69 - j4.21$$

$$\hat{I}_3 = \frac{1500}{230 \times 0.95} \angle^{j \cos^{-1} 0.95} = 6865 \angle^{18.19^\circ} = 652 + j2.14$$

$$\left. \begin{aligned} \text{so } \hat{I}_0 &= \hat{I}_1 + \hat{I}_2 = 10.87 - j1.12 = 10.93 \angle^{-5.88^\circ} \\ \hat{I}_b &= \hat{I}_0 + \hat{I}_3 = 15.21 - j2.07 = 15.35 \angle^{-7.75^\circ} \end{aligned} \right\}$$



converting Y to Δ gives $Z_{\Delta} = 3Z_Y = 9 + j12$
equiv:

this gives a balanced Δ load with impedances of $(5 - j12)$ in parallel with $9 + j12$

$$Z_{\Delta \text{ total}} = \frac{(5 - j12)(9 + j12)}{14} = \frac{130 \angle 67.38^\circ \cdot 15 \angle 53.13^\circ}{14} = 13.930 \angle -14.25^\circ$$

$$I_{\Delta} = \frac{120}{Z_{\Delta \text{ total}}} = \frac{120}{13.93} \angle 14.25^\circ = 8.615 \angle 14.25^\circ$$

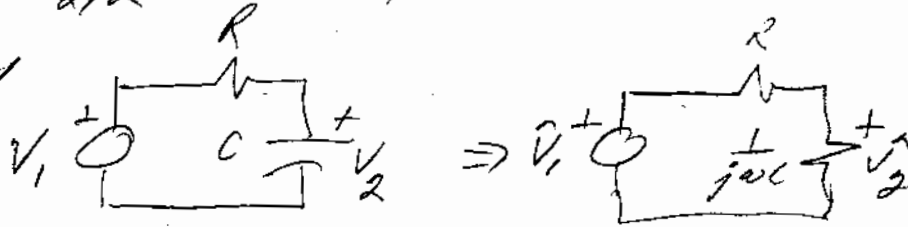
$$P_{\text{ave total}} = 3 \times P_{\phi} = 3 \times 120 \times 8.615 \cos(-14.25^\circ) = 3005.97 \text{ W}$$

$$\text{pf} = \cos(14.25^\circ) = 0.97 \text{ leading}$$

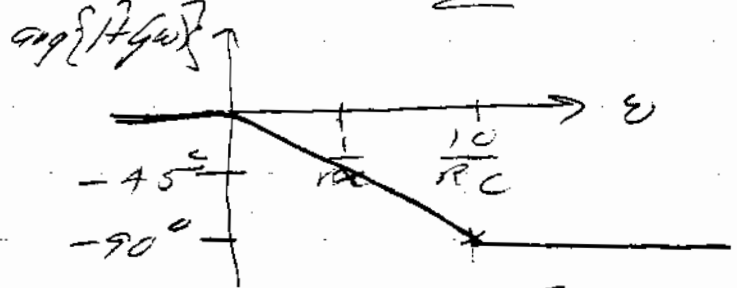
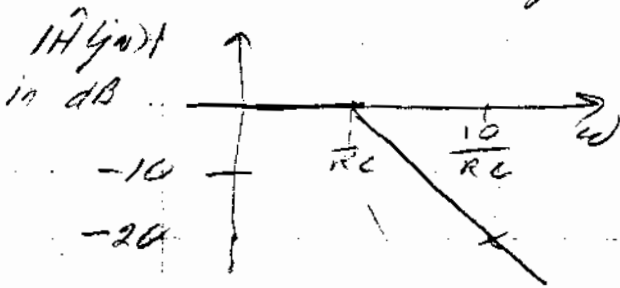
If you assume the 120 V_{rms} is line to neutral then

$$P_{\text{ave total}} = 3 \times 3005.97 = 9017.9 \text{ Watts}$$

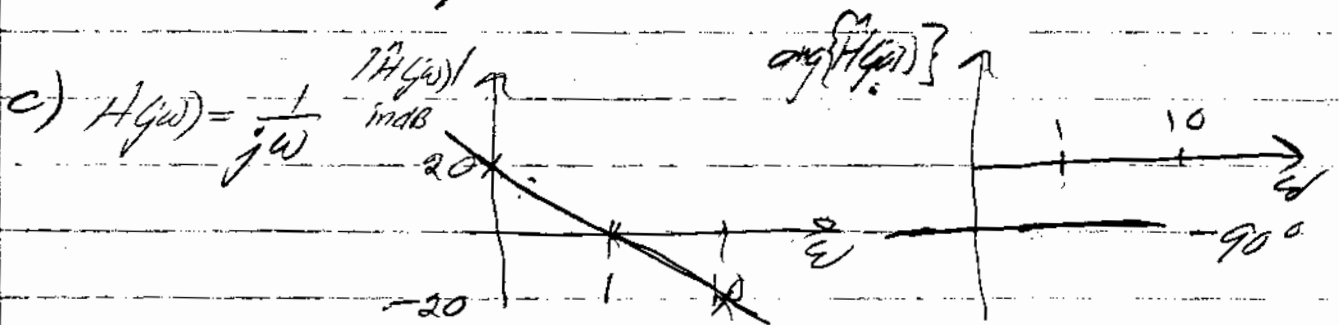
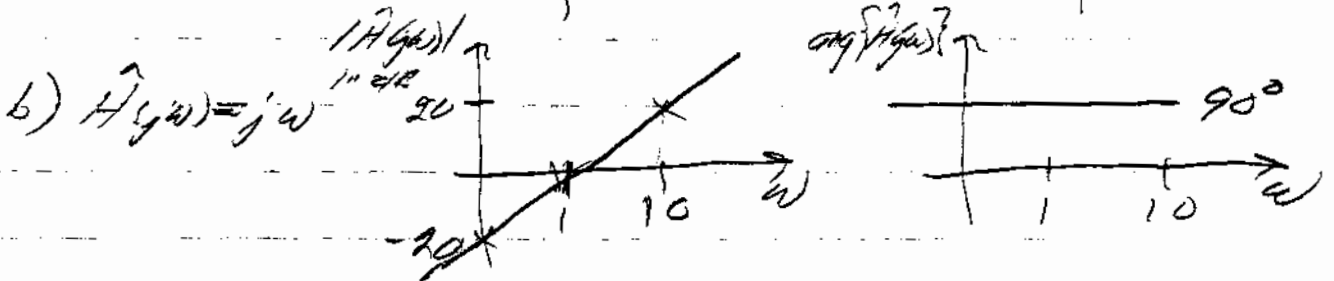
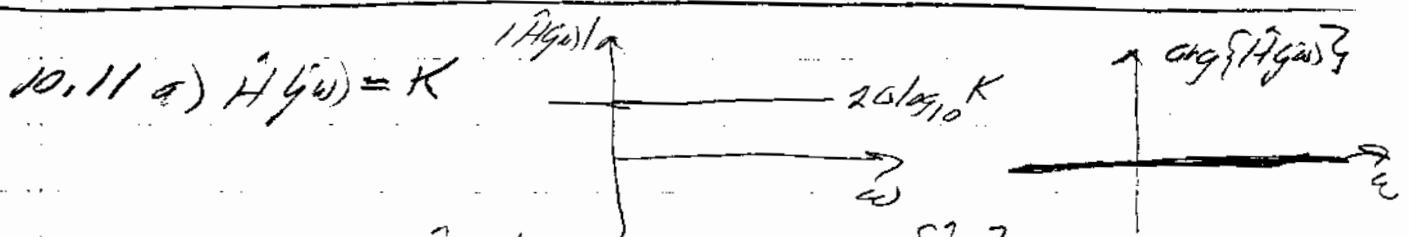
10.1



$$\hat{H}(j\omega) = \frac{\hat{V}_2}{\hat{V}_1} = \frac{\frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{1}{1 + j\omega RC} \quad (\text{low pass})$$



half power when $\omega RC = 1$ or $\omega = \frac{1}{RC}$

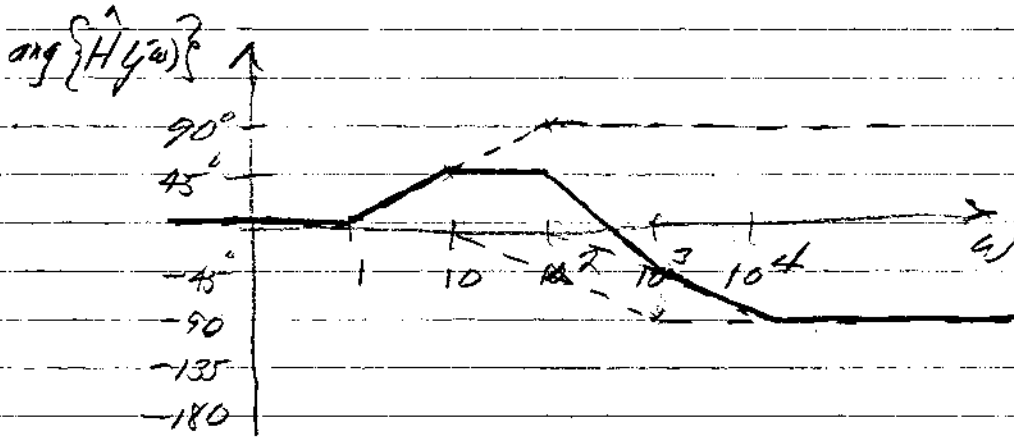
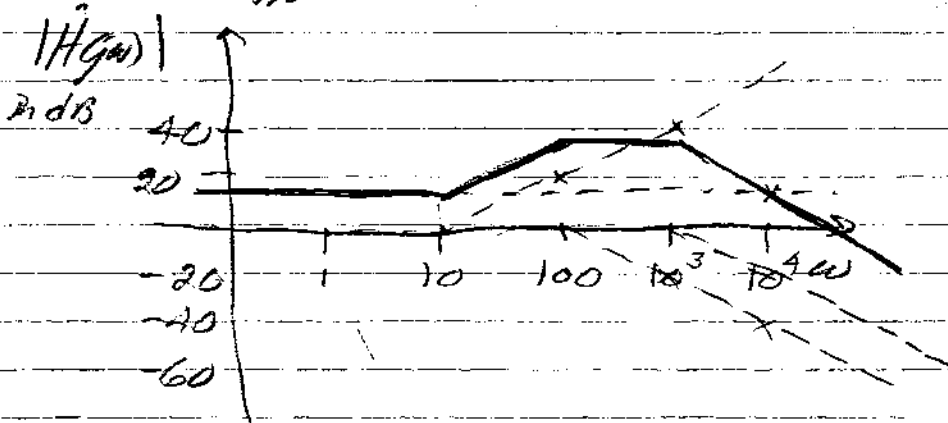


EE 211

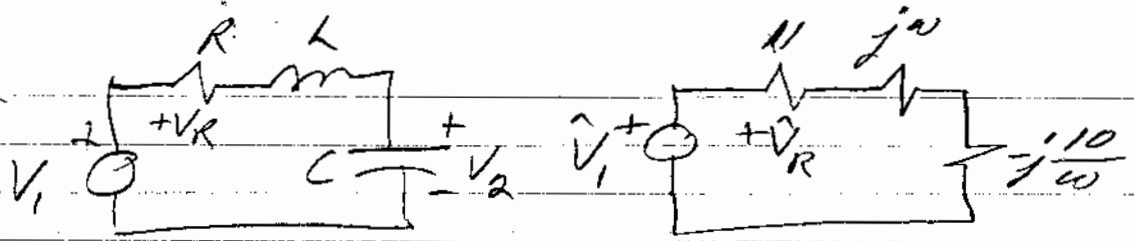
Homework 4

Special Bode plot for $H(s) = \frac{5(1+j\frac{\omega}{10})}{(1+j\frac{\omega}{100})(1+j\frac{\omega}{10000})}$

$20 \log_{10} 5 \approx 14 \text{ dB}$



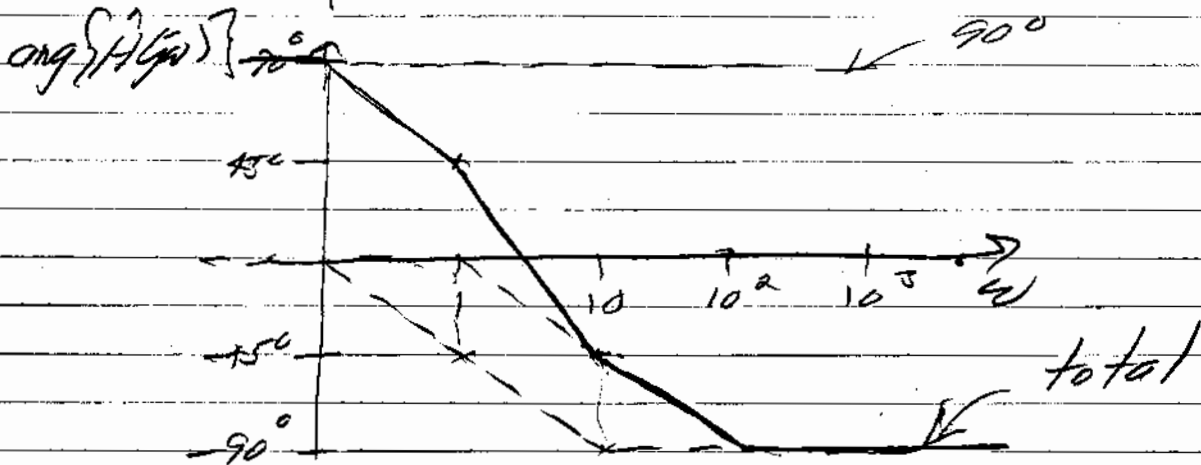
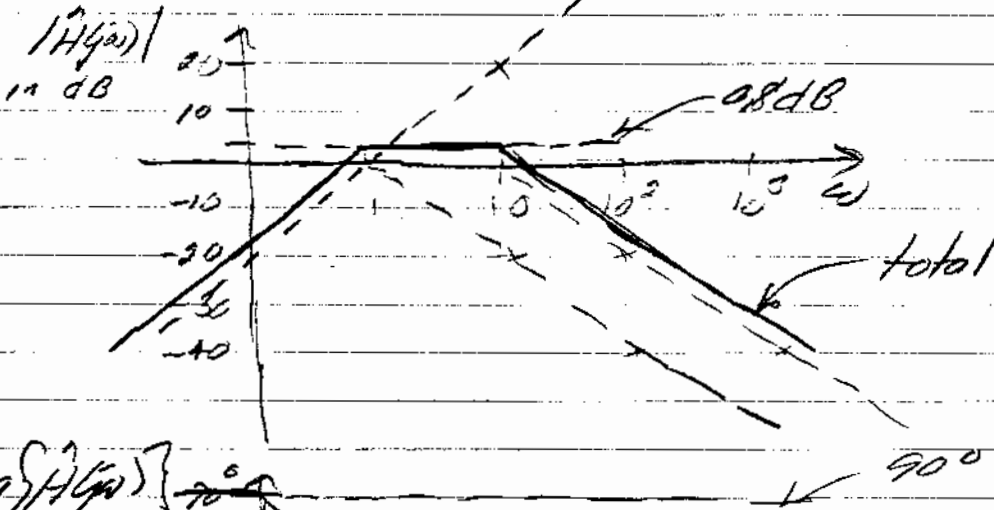
10.12

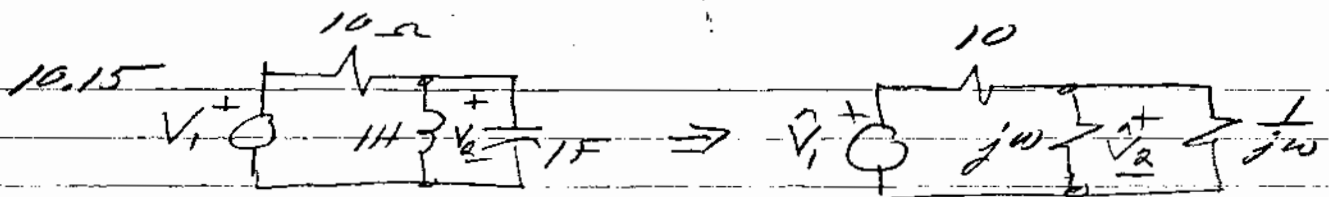


$$\hat{H}(j\omega) = \frac{\hat{V}_R}{\hat{V}_1} = \frac{11}{11 + j\omega + \frac{10}{j\omega}} = \frac{11j\omega}{(j\omega)^2 + 11j\omega + 10}$$

$$\hat{H}(j\omega) = \frac{11j\omega}{(j\omega + 1)(j\omega + 10)} = \frac{11}{10} \times \frac{j\omega}{(1 + j\omega)(1 + j\frac{\omega}{10})}$$

$$20 \log_{10} \left(\frac{11}{10} \right) = 0.828$$





$$\hat{H}(j\omega) = \frac{V_2}{V_1} = \frac{1}{j\omega + \frac{1}{j\omega}} = \frac{j\omega}{(j\omega)^2 + 1} = \frac{j\omega}{10 + \frac{j\omega}{(j\omega)^2 + 1}}$$

$$\hat{H}(j\omega) = \frac{j\omega}{10(j\omega)^2 + j\omega + 10} = \frac{(\frac{1}{10})j\omega}{(j\omega)^2 + 1 + j\frac{\omega}{10}}$$

$$20 \log_{10} |\hat{H}(j\omega)| = 20 \log_{10} \omega + 20 \log_{10} (10^{-1}) - 20 \log_{10} \sqrt{[1 - (\omega)^2]^2 + [\frac{\omega}{10}]^2}$$

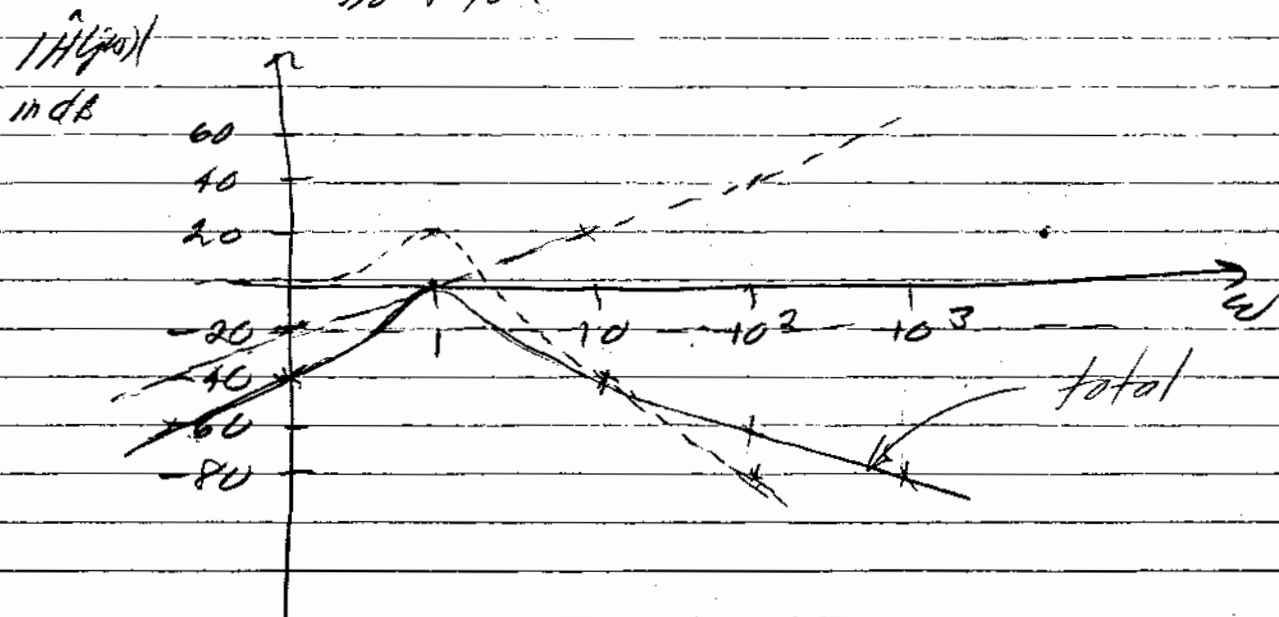
$\rightarrow = -20 \text{ dB}$

For large ω this becomes $-20 \log_{10} \omega^2$

\rightarrow This is a curve of slope -20 dB/decade and a corner frequency of $\omega = 1$

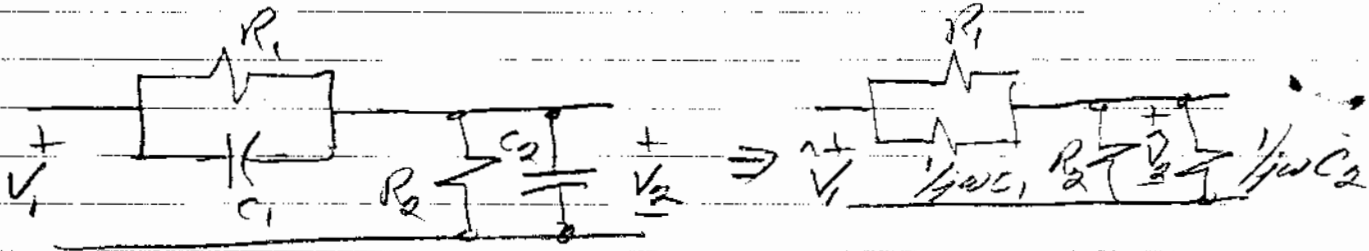
At $\omega = 1$ the magnitude of this last term is:

$$-20 \log_{10} \sqrt{\frac{1}{10^2}} = 20 \text{ dB}$$



Special Problem

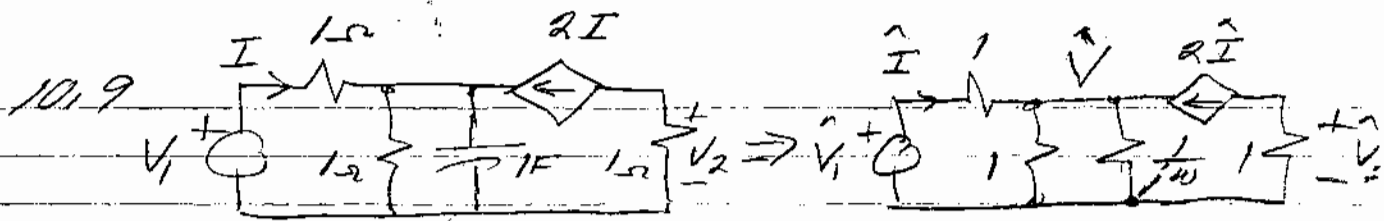
x10 scope probe



$$\frac{V_2}{V_1} = \frac{\frac{R_1 j\omega C_2}{R_1 + \frac{1}{j\omega C_1}}}{R_2 + \frac{1}{j\omega C_2}} = \frac{\frac{R_2}{1 + j\omega R_2 C_2}}{\frac{R_1}{1 + j\omega R_1 C_1} + \frac{R_2}{1 + j\omega R_2 C_2}}$$

If $R_1 C_1 = R_2 C_2$ then $\frac{V_2}{V_1} = \frac{R_2}{R_1 + R_2}$

EE 212 Homework 7



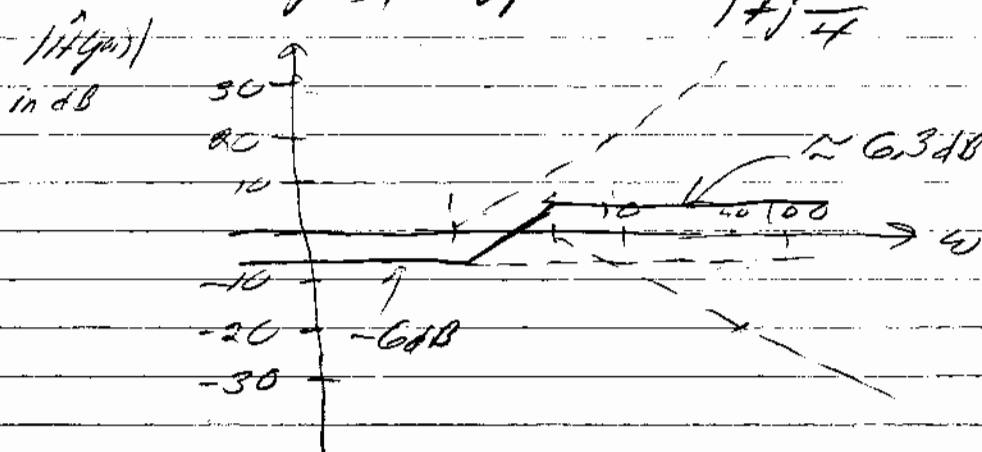
$$\underline{H(j\omega)} = \frac{\hat{V}_2}{\hat{V}_1} \quad \frac{\hat{V} - \hat{V}_1}{1} + \frac{\hat{V}}{1} + j\omega \hat{V} - 2\hat{I} = 0 \quad \text{but } \hat{I} = \frac{\hat{V} - \hat{V}_1}{1}$$

$$\therefore \hat{V}(1 + 1 + j\omega + 2) = \hat{V}_1 + 2\hat{V}_1$$

$$\hat{V} = \frac{3\hat{V}_1}{4 + j\omega} \quad \text{and } \hat{V}_2 = -2\hat{I} = -2\left(\frac{\hat{V}_1 - \hat{V}}{1}\right)$$

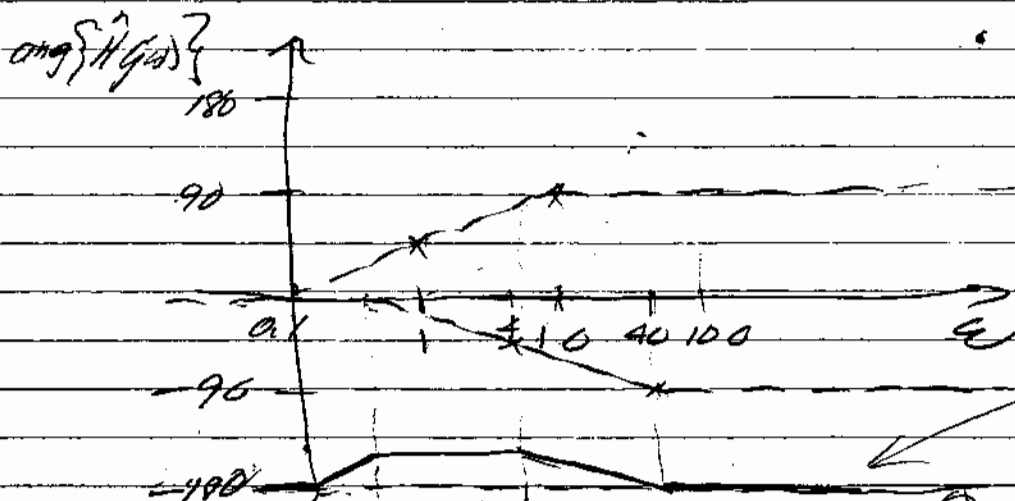
$$\therefore \hat{V}_2 = -2\left(\hat{V}_1 - \frac{3\hat{V}_1}{4 + j\omega}\right) = -2\hat{V}_1 \left(\frac{4 + j\omega - 3}{4 + j\omega}\right) = \hat{V}_1 \frac{-2 - j2\omega}{4 + j\omega}$$

$$\text{or } |H(j\omega)| = \frac{\hat{V}_2}{\hat{V}_1} = -\frac{1}{2} \frac{1 + j\omega}{1 + j\frac{\omega}{4}} \quad ; \quad 20 \log_{10}\left(\frac{1}{2}\right) = -6 \text{ dB}$$



$$20 \log_{10} \sqrt{17} = 12.3 \text{ dB}$$

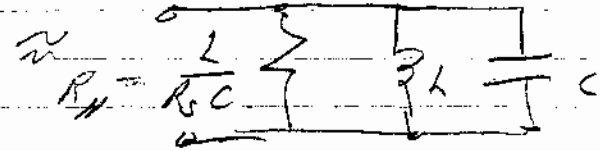
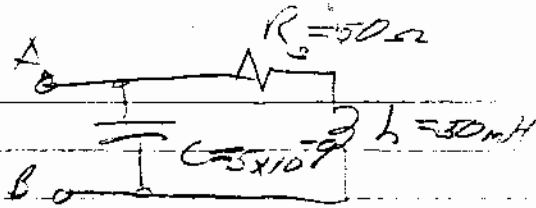
$$12.3 - 6 = 6.3 \text{ dB}$$



(could be +180° for (-1) term)

from (-1) term

10-33



$$R_H = \frac{L}{R_s C} = \frac{50 \times 10^{-3}}{50 \times 5 \times 10^{-9}} = 0.2 \times 10^6 = \boxed{200 \text{ k}\Omega}$$

$$Q = \frac{\omega_r L}{R_s} = \frac{L}{R_s} \cdot \frac{1}{\sqrt{LC}} = \frac{1}{R_s} \sqrt{\frac{L}{C}}$$

$$Q = \frac{1}{50} \sqrt{\frac{50 \times 10^{-3}}{5 \times 10^{-9}}} = 0.02 \sqrt{\frac{10^{-2}}{10^{-9}}} = \boxed{63.24}$$

10-34



$$K_R = 5 \times 10^3$$

$$K_C = 10^5$$

scaled circuit



$$R_{\text{new}} = 5 \times 10^3 \times 2 = 10^4$$

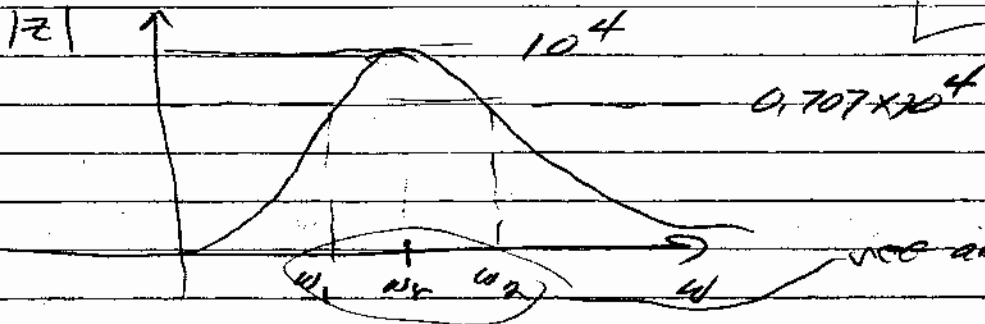
$$L_{\text{new}} = \frac{5 \times 10^3}{10^5} L = 5 \times 10^{-2}$$

$$C_{\text{new}} = \frac{C}{5 \times 10^3 \times 10^5} = 8 \times 10^{-11}$$

$$\omega_r = \frac{1}{\sqrt{R_{\text{new}} C_{\text{new}}}} = \frac{1}{\sqrt{10^4 \times 8 \times 10^{-11}}} = \boxed{5 \times 10^5}$$

$$Q = R \sqrt{\frac{C}{L}} = 10^4 \sqrt{\frac{8 \times 10^{-11}}{5 \times 10^{-2}}} = \boxed{0.4}$$

$$\omega_{1,2} = \frac{\omega_r}{2Q} \pm \omega_r \sqrt{\left(\frac{1}{2Q}\right)^2 + 1} = \pm 6.25 \times 10^5 \pm 8 \times 10^5 = \left\{ \begin{array}{l} 14.25 \times 10^5 \\ 1.75 \times 10^5 \end{array} \right\}$$



see above for values

$$11.1 \ a) \ \mathcal{L} [2e^{-8t} - e^{-2t}] u(t) = \frac{2}{s+8} - \frac{1}{s+2}$$

$$b) \ \mathcal{L} [(6+2e^{-6t} - 12e^{-t}) u(t)] = \frac{6}{s} + \frac{2}{s+6} - \frac{12}{s+1}$$

$$c) \ \mathcal{L} [(s+3)e^{-2t}] u(t) = \frac{2}{s+2} + \frac{3}{(s+2)^2}$$

$$d) \ \mathcal{L} [\cos 4t - \sin 4t] e^{-3t} u(t) = \frac{s+3}{(s+3)^2+16} - \frac{4}{(s+3)^2+16}$$

$$11.3 \ a) \ \mathcal{L} [\sin(\beta t - \phi)] u(t) = \cos \phi \frac{\beta}{s^2 + \beta^2} - \sin \phi \frac{s}{s^2 + \beta^2}$$

$$b) \ \mathcal{L} [\cos(\beta t - \phi)] u(t) = \cos \phi \frac{s}{s^2 + \beta^2} + \sin \phi \frac{\beta}{s^2 + \beta^2}$$

$$c) \ \mathcal{L} [e^{-\alpha t} \sin(\beta t - \phi)] u(t) = \cos \phi \frac{\beta}{(s+\alpha)^2 + \beta^2} - \sin \phi \frac{(s+\alpha)}{(s+\alpha)^2 + \beta^2}$$

$$d) \ \mathcal{L} [e^{-\alpha t} \cos(\beta t - \phi)] u(t) = \cos \phi \frac{(s+\alpha)}{(s+\alpha)^2 + \beta^2} + \sin \phi \frac{\beta}{(s+\alpha)^2 + \beta^2}$$

$$11.11 \ a) \ F(s) = \frac{6}{s(s+1)(s+3)} = \frac{2}{s} + \frac{-3}{s+1} + \frac{1}{s+3}$$

$$\circ \circ \ f(t) = \{ 2 - 3e^{-t} + e^{-3t} \} u(t) \quad \leftarrow$$

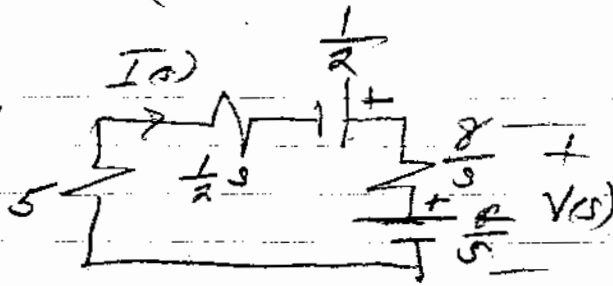
$$b) \ F(s) = \frac{60(s+4)}{s(s+2)(s+12)} = \frac{10}{s} + \frac{-6}{s+2} + \frac{-4}{s+12}$$

$$f(t) = \{ 10 - 6e^{-2t} - 4e^{-12t} \} u(t) \quad \leftarrow$$

EE 212

Homework 11

11.21



$$i(0) = 1$$

$$v(0) = 2$$

$$I(s) = \frac{\frac{1}{2} - \frac{2}{s}}{5 + \frac{5}{2} + \frac{8}{s}} = \frac{s - 4}{s^2 + 10s + 16} = \frac{s - 4}{(s+2)(s+8)}$$

$$\text{or } I(s) = \frac{-1}{s+2} + \frac{2}{s+8}$$

$$i(t) = \left\{ 2e^{-8t} - e^{-2t} \right\} u(t) \quad \leftarrow$$

$$V(s) = I(s) \frac{8}{s} + \frac{2}{s} = \frac{8(s-4)}{s(s+2)(s+8)} + \frac{2}{s}$$

$$V(s) = \frac{0}{s} + \frac{8(-6)}{s+2} + \frac{8(-12)}{s+8} = \frac{4}{s+2} - \frac{2}{s+8}$$

$$v(t) = \left\{ 4e^{-2t} - 2e^{-8t} \right\} u(t) \quad \leftarrow$$

$$11.14 b) F(s) = \frac{(s+2)(s+3)}{s(s+1)^2} = \frac{1}{s+1} \left\{ \frac{(s+2)(s+3)}{s(s+1)} \right\}$$

$$\begin{array}{l} \frac{s^2+5s+6}{s^2+s} = \frac{4s+6}{s+1} \\ \frac{4s+6}{s+1} \end{array} \quad \therefore F(s) = \frac{1}{s+1} \left\{ \frac{4s+6}{s(s+1)} + 1 \right\}$$

$$F(s) = \frac{1}{s+1} \left\{ 1 + \frac{6}{s} - \frac{2}{s+1} \right\} = \frac{1}{s+1} + \frac{6}{s(s+1)} - \frac{2}{(s+1)^2}$$

$$F(s) = \frac{1}{s+1} + \frac{6}{s} + \frac{-6}{s+1} - \frac{2}{(s+1)^2} = \frac{6}{s} - \frac{5}{s+1} - \frac{2}{(s+1)^2}$$

$$\therefore f(t) = \left\{ 6 - 5e^{-t} - 2te^{-t} \right\} u(t)$$

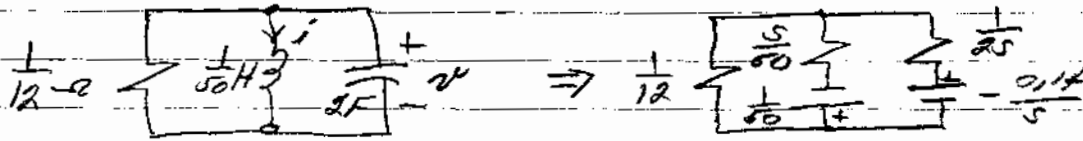
$$11.14 c) F(s) = \frac{4(1-e^{-2s})}{s^2(s+2)} = \left\{ \frac{K_1}{s} + \frac{K_2}{s^2} + \frac{1}{s+2} \right\} (1-e^{-2s})$$

$$\frac{d}{ds} \left\{ F(s) s^2 \right\}_{s=0} = K_2 = 4(-1)(s+2)^{-2} \Big|_{s=0} = -1$$

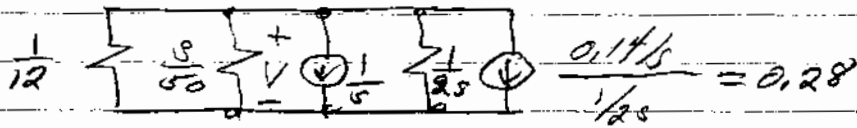
$$\therefore F(s) = \left\{ -\frac{1}{s} + \frac{2}{s^2} + \frac{1}{s+2} \right\} (1-e^{-2s})$$

$$f(t) = \left\{ -1 + 2t + e^{-2t} \right\} u(t) - \left\{ -1 + 2(t-2) + e^{-2(t-2)} \right\} u(t-2)$$

$$1/122 \text{ (N4) only) } v(0) = -0.14V ; i(0) = 1A$$



converting to current sources



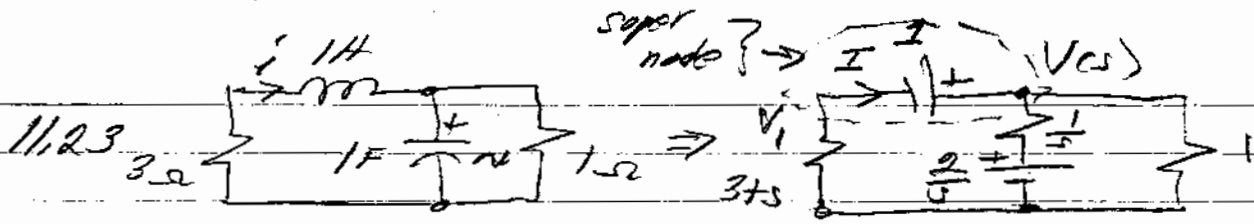
$$\text{KCL } 12V + \frac{50V}{s} + \frac{1}{s} + V(25) + 0.28 = 0$$

$$V = - \frac{\frac{1}{s} + 0.28}{12 + \frac{50}{s} + 25} = - \frac{1 + 0.28s}{25^2 + 125 + 50} = - \frac{0.5 + 0.14s}{s^2 + 6s + 25}$$

$$V(s) = - \frac{0.14(s+3) + 0.08(\frac{4}{s})}{(s+3)^2 + 16}$$

$$v_o(t) = - \left\{ 0.14e^{-3t} \cos 4t + 0.08e^{-3t} \sin 4t \right\} \text{ (V)}$$

EE 212 Homework 14



$v(0) = 2, i(0) = 1$

$$\frac{V_1}{3+s} + \frac{V - \frac{2}{s}}{1} + \frac{V}{1} = 0 \quad ; \quad V - V_1 = 1$$

so $\frac{V-1}{s+3} + \frac{V - \frac{2}{s}}{1} + V = 0 = \frac{V-1}{s+3} + Vs - 2 + V = 0$

or $V-1 + (Vs - 2 + V)(s+3) = 0 = V-1 + Vs^2 + 3Vs - 2s - 6 + Vs + 3V$

$$V(s^2 + 4s + 4) = 1 + 6 + 2s = 2s + 7$$

$$V = \frac{2s+7}{s^2+4s+4} = \frac{2s+7}{(s+2)^2} = \frac{2}{(s+2)} + \frac{3}{(s+2)^2}$$

so $i_A(t) = [2e^{-2t} + 3te^{-2t}] u(t)$

$$I_A(s) = -\frac{V_1}{3+s} = \frac{1-V}{3+s} = \frac{1 - \frac{2s+7}{(s+2)^2}}{s+3} = \frac{1}{s+3} - \frac{2s+7}{(s+3)(s+2)^2}$$

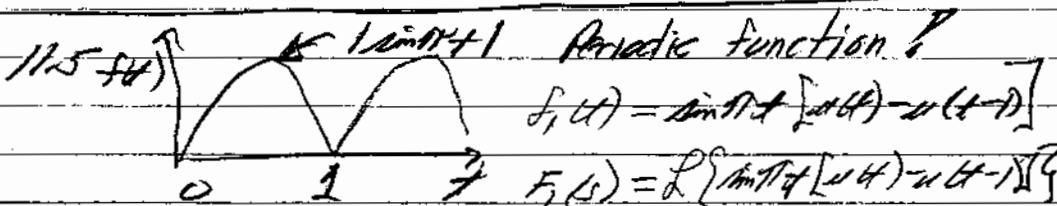
$$\frac{2s+7}{(s+3)(s+2)^2} = \frac{1}{s+3} + \frac{K}{s+2} + \frac{3}{(s+2)^2}$$

$$2s+7 = (s+2)^2 + K(s+2)(s+3) + 3(s+3)$$

s^2 terms: $0 = 1 + K \quad ; \quad K = -1$

so $I_A(s) = \frac{1}{s+3} - \frac{1}{s+2} + \frac{1}{s+2} - \frac{3}{(s+2)^2}$

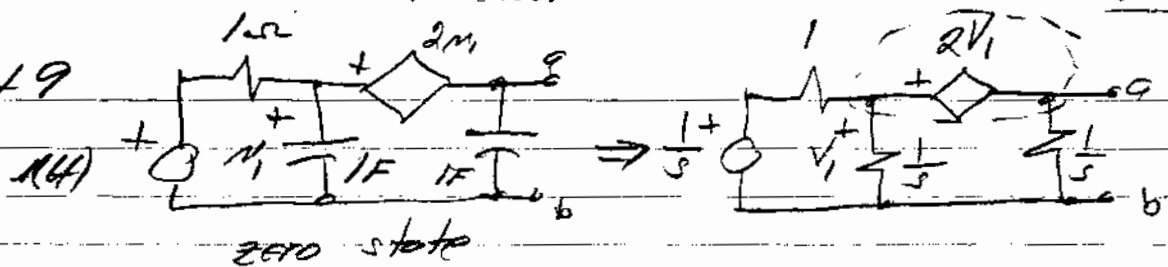
or $i_A(t) = [e^{-2t} - 3te^{-2t}] u(t)$



but $\sin(\pi(t-1)) = \sin(\pi t - \pi) = -\sin(\pi t)$

so $F_1(s) = \mathcal{L}\{\sin(\pi t) u(t) - \sin(\pi(t-1)) u(t-1)\} ; \mathcal{L}\{f_1(t)\} = \left\{ \frac{\pi}{s^2 + \pi^2} - \frac{\pi e^{-s}}{s^2 + \pi^2} \right\} \frac{1}{1 - e^{-s}}$

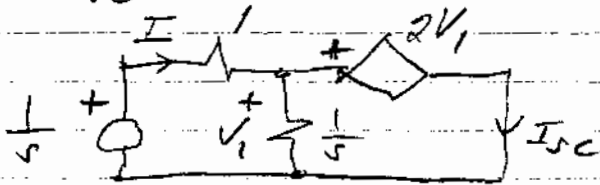
11.49



$$\frac{V_1 - \frac{1}{5}}{1} + \frac{V_1}{\frac{1}{5}} + \frac{V_{Th}}{\frac{1}{5}} = 0 \quad \text{but } V_1 - V_{Th} = 2V_1; \quad V_{Th} = -V_1$$

$$\therefore V_1 = \frac{1}{5} \quad \text{or } \boxed{V_{Th} = -\frac{1}{5}} \leftarrow$$

For I_{sc} we have:

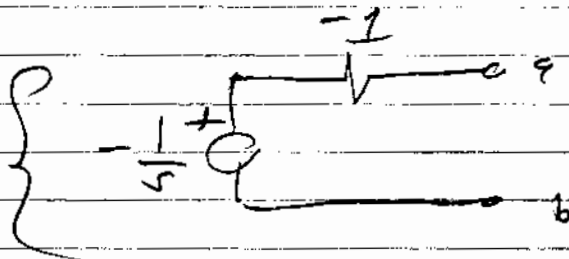


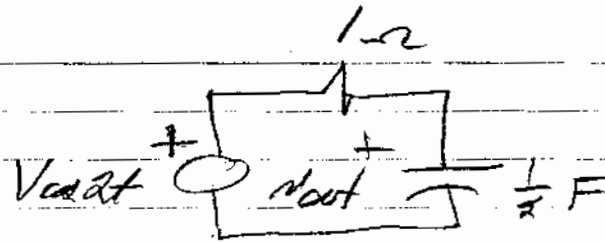
We see from circuit $V_1 = 2V_1$

$$\therefore V_1 = 0$$

$$\therefore I = I_{sc} = \frac{1}{5} / 1 = \frac{1}{5}$$

$$\text{so } Z_{Th} = \frac{V_{Th}}{I_{sc}} = -1$$



Specialzero state

$$\frac{V_s}{s^2+4} \quad \frac{2}{s} \quad V_{out} \quad V_{out} = \frac{\frac{2}{s}}{1+\frac{2}{s}} \cdot \frac{V_s}{s^2+4}$$

$$V_{out} = V_s \frac{2s}{(s+2)(s^2+4)} = V_s \left\{ \frac{K_1}{s+2} + \frac{K_2s+K_3}{s^2+4} \right\}$$

$$\boxed{K_1 = -\frac{1}{2}}; \quad 2s = -\frac{1}{2}(s^2+4) + (K_2s+K_3)(s+2)$$

$$s^2 \text{ terms: } 0 = -\frac{1}{2} + K_2 \quad ; \quad \boxed{K_2 = \frac{1}{2}}$$

$$s \text{ terms: } 2 = 1 + K_3 \quad ; \quad \boxed{K_3 = 1}$$

$$V_{out} = V_s \left\{ \frac{-\frac{1}{2}}{s+2} + \frac{\frac{1}{2}s+1}{s^2+4} \right\}$$

$$\boxed{V_{out}(t) = V_s \left\{ -\frac{1}{2} e^{-2t} + \frac{1}{2} \cos 2t + \frac{1}{2} \sin 2t \right\} u(t)} \quad \leftarrow$$

$$11.65 \quad h(t) = e^{-2t} u(t) ; \quad x(t) = 2u(t) - 2(t-1)$$

$$y(t) = \int_0^t e^{-2(t-\tau)} [2u(\tau-1) - 2(\tau-1)] d\tau$$

$$y(t) = \int_0^t e^{-2t} e^{2\tau} d\tau - 2 \int_0^{t-1} e^{-2t} e^{2\tau} d\tau$$

$$y(t) = -e^{-2t} \left|_0^t e^{2\tau} \right| + e^{-2t} \left|_0^{t-1} e^{2\tau} \right|$$

$$y(t) = [1 - e^{-2t}] u(t) - [1 - e^{-2(t-1)}] u(t-1) \quad \leftarrow$$

$$11.51 \quad H(s) = \frac{1}{s+2}$$

$$a) \quad x(t) = u(t) ; \quad Y(s) = \frac{1}{s(s+2)} = \frac{\frac{1}{2}}{s} + \frac{-\frac{1}{2}}{s+2}$$

$$\text{so } y(t) = \left[\frac{1}{2} - \frac{1}{2} e^{-2t} \right] u(t) \quad \leftarrow$$

$$b) \quad x(t) = e^{-t} u(t) ; \quad Y(s) = \frac{1}{(s+1)(s+2)} = \frac{1}{s+1} + \frac{-1}{s+2}$$

$$y(t) = [e^{-t} - e^{-2t}] u(t) \quad \leftarrow$$

$$c) \quad x(t) = (1 - e^{-t}) u(t) ; \quad X(s) = \frac{1}{s} - \frac{1}{s+1}$$

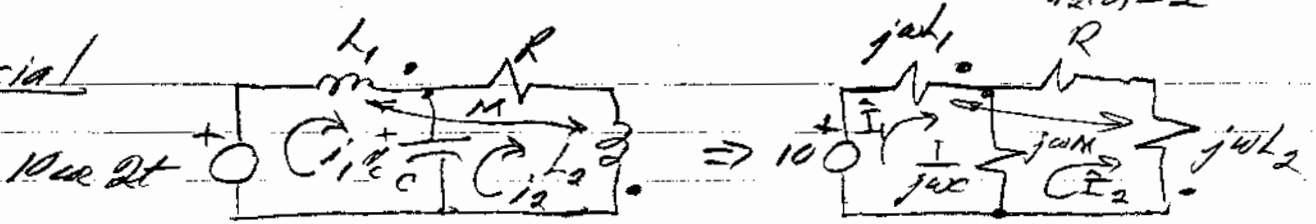
$$Y(s) = \frac{1}{s(s+2)} - \frac{1}{(s+1)(s+2)}$$

$$\text{so from a) + b) } y(t) = \left[\frac{1}{2} - e^{-t} + \frac{1}{2} e^{-2t} \right] u(t) \quad \leftarrow$$

$$d) \quad x(t) = e^{-2t} u(t) ; \quad X(s) = \frac{1}{s+2} \quad \text{so } Y(s) = \frac{1}{(s+2)^2}$$

$$y(t) = t e^{-2t} u(t) \quad \leftarrow$$

Special



time domain

$$a) \left\{ \begin{aligned} 10 \cos 2t &= L_1 \frac{di_1}{dt} + M \frac{di_2}{dt} + \frac{1}{C} \int_0^t (i_1 - i_2) dt + v_c(0) \\ 0 &= \frac{1}{C} \int_0^t (i_2 - i_1) dt - v_c(0) + i_2 R + L_2 \frac{di_2}{dt} + M \frac{di_1}{dt} \end{aligned} \right\} \leftarrow$$

sinusoidal steady state

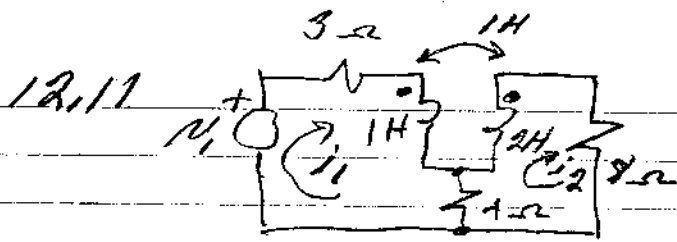
$$b) \left\{ \begin{aligned} 10 &= j\omega L_1 \hat{I}_1 + j\omega M \hat{I}_2 + \frac{1}{j\omega C} (\hat{I}_1 - \hat{I}_2) \\ 0 &= \frac{1}{j\omega C} (\hat{I}_2 - \hat{I}_1) + R \hat{I}_2 + j\omega L_2 \hat{I}_2 + j\omega M \hat{I}_1 \end{aligned} \right\} \leftarrow$$

s-domain

$$c) \left\{ \begin{aligned} \frac{10s}{s^2+4} &= sL_1 I_1 - L_1 i_1(0) + sM I_2 - M i_2(0) + \frac{1}{sC} (I_1 - I_2) + \frac{v_c(0)}{s} \\ 0 &= \frac{1}{sC} (I_2 - I_1) - \frac{v_c(0)}{s} + R I_2 + sL_2 I_2 - L_2 i_2(0) + M s I_1 - M i_1(0) \end{aligned} \right\}$$

$$\left\{ \begin{aligned} \frac{10s}{s^2+4} &= sL_1 I_1 - L_1 + sM I_2 - 2M + \frac{1}{sC} (I_1 - I_2) \\ 0 &= \frac{1}{sC} (I_2 - I_1) + R I_2 + sL_2 I_2 - 2L_2 + M s I_1 - M \end{aligned} \right\} \leftarrow$$

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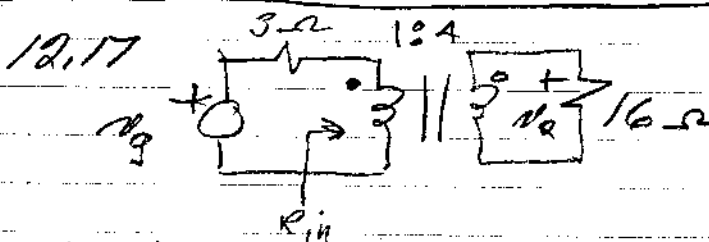
$$H(s) = \frac{V_2(s)}{V_1(s)}$$

$$V_2(s) = 8I_2(s)$$

$$\left. \begin{aligned} V_1 &= 3I_1 + sI_1 - sI_2 + 4(I_1 - I_2) \\ 0 &= 4(I_2 - I_1) + 8sI_2 - sI_1 + 8I_2 \end{aligned} \right\} \begin{aligned} V_1 &= I_1(7+s) - I_2(s+4) \\ 0 &= -I_1(s+4) + I_2(12+2s) \end{aligned}$$

$$\text{so } I_2 = \frac{\begin{vmatrix} 7+s & V_1 \\ -s-4 & 0 \end{vmatrix}}{\begin{vmatrix} 7+s & -(s+4) \\ -s-4 & 12+2s \end{vmatrix}} = \frac{V_1(s+4)}{(7+s)(12+2s) - (s+4)^2} = \frac{V_1(s+4)}{s^2 + 18s + 68}$$

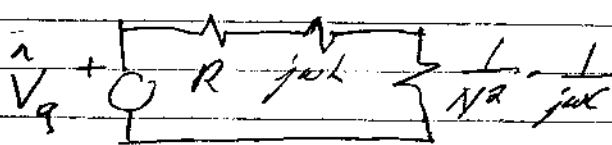
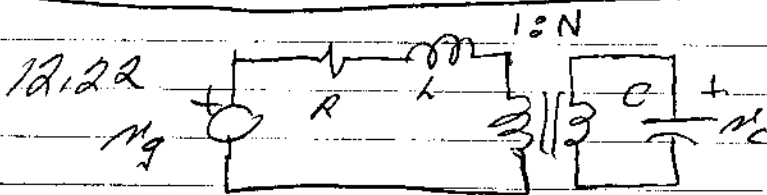
$$I_2 = \frac{V_1(s+4)}{s^2 + 18s + 68} ; \boxed{H(s) = \frac{8(s+4)}{s^2 + 18s + 68}}$$



a) $\boxed{Z = 3 + 1 = 4 \Omega}$

b) $\boxed{R_x = \frac{1}{4} \times 16 = 4 \Omega}$

c) for maximum power $R_{in} = 3 = \frac{1}{16} R_x \therefore \boxed{R_x = 48 \Omega}$

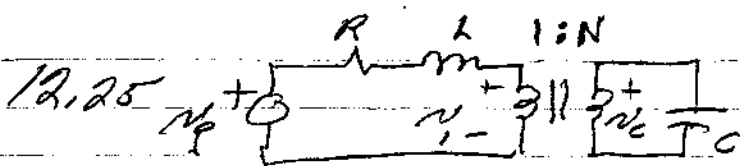


RLC series circuit with equivalent capacitance equal $N^2 C$

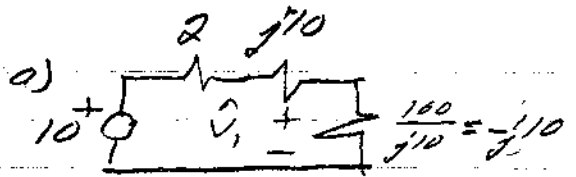
a) $\omega_0 = \frac{1}{\sqrt{LC}} = \boxed{\frac{1}{N\sqrt{LC}}}$

b) $Q = \omega_0 \frac{L}{R} = \frac{L}{RN\sqrt{LC}} = \boxed{\sqrt{\frac{L}{C}} \cdot \frac{1}{NR}}$

c) $BW = \frac{\omega_0}{Q} = \frac{\frac{1}{N\sqrt{LC}}}{\frac{L}{RN\sqrt{LC}}} = \boxed{\frac{R}{L}}$

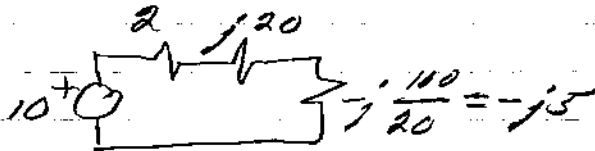


$\omega = 5, R = 2, L = 2, C = 2, N = 1/10$



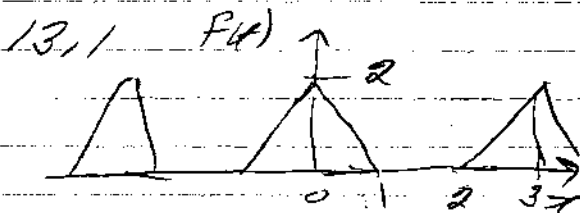
$\hat{V}_1 = 10 \frac{j10}{2} = j50 \therefore \hat{V}_c = -j5, N_c(t) = 5 \cos(5t - 90^\circ)$

b) $N_c(t) = 10 \cos 10t$



$\hat{V}_1 = 10 \frac{-j5}{2 + j5} = \frac{50 - j100}{15.13 \angle 89.44^\circ} = 0.33 \angle -172.4^\circ$

$N_c(t) = 0.33 \cos(10t - 172.4^\circ)$



even function $\therefore b_n = 0$

$a_0 = \frac{2}{3}$

$\pi = 3$

$a_n = \frac{4}{\pi} \int_0^1 (-2t + 2) \cos \frac{n2\pi t}{3} dt$

$a_n = -\frac{8}{3} \int_0^1 t \cos \frac{2n\pi t}{3} dt + \frac{8}{3} \int_0^1 \cos \frac{2n\pi t}{3} dt$

$u = t \quad du = \cos \frac{2n\pi t}{3} dt$

$dv = dt \quad v = \frac{3}{2n\pi} \sin \frac{2n\pi t}{3}$

$a_n = -\frac{8}{3} t \frac{3}{2n\pi} \sin \frac{2n\pi t}{3} \Big|_0^1 + \frac{8}{3} \int_0^1 \frac{3}{2n\pi} \sin \frac{2n\pi t}{3} dt + \frac{8}{3} \frac{3}{2n\pi} \sin \frac{2n\pi t}{3} \Big|_0^1$

$a_n = -\frac{8}{2n\pi} \sin \frac{2n\pi}{3} - \frac{8}{2n\pi} \frac{3}{2n\pi} \cos \frac{2n\pi t}{3} \Big|_0^1 + \frac{8}{2n\pi} \sin \frac{2n\pi}{3}$

$a_n = \frac{6}{(n\pi)^2} \left[1 - \cos \left(\frac{2n\pi}{3} \right) \right]$

