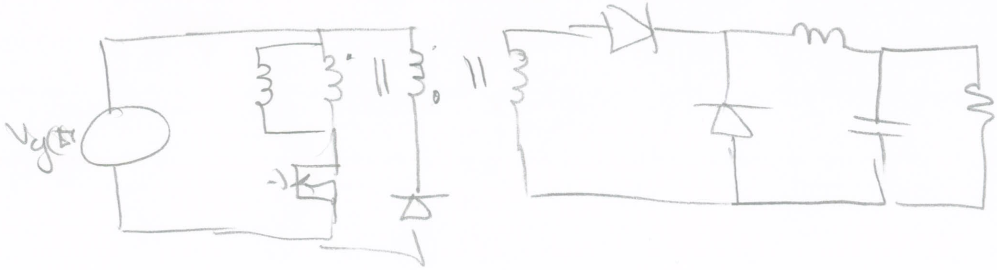
8.22



$$\langle V_{Lm} \rangle = V_g d_1 - V_g d_2 + 0$$

$$L\frac{d\langle i_L\rangle}{dt} = \langle V_L \rangle = \frac{n_3}{n_1} V_g d - V = \frac{n_3}{n_1}\left[(V_g+\hat{v}_g)(D+\hat{d})\right] - V + v$$

$$0 = \frac{n_3}{n_1} V_g D - V$$

$$L\frac{d\hat{i}_L}{dt} = \frac{n_3}{n_1}\left[\hat{v}_g D + V_g \hat{d}\right] - \hat{v}$$

$$C\frac{d\langle v\rangle}{dt} = \langle i_c \rangle = i_L - \frac{v}{R} = I_L + \hat{i}_L - \frac{\hat{v}+V}{R}$$

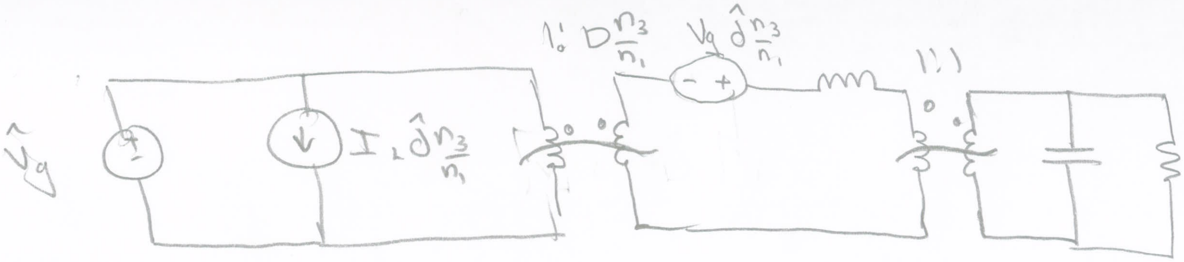
$$0 = I_L - \frac{V}{R}$$

$$C\frac{d\hat{v}}{dt} = \hat{i}_L - \frac{\hat{v}}{R}$$

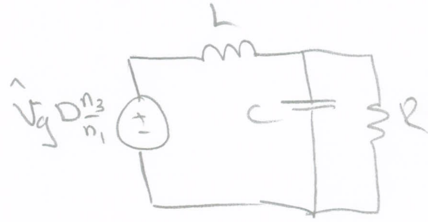
$$\langle i_g \rangle = \frac{1}{T}\int_0^T i_g\, dt = \frac{1}{T}\int_0^{d_1 T} i_L \frac{n_3}{n_1} + i_{Lm}\, dt + \frac{1}{T}\int_0^{d_2 T} -i_{Lm}\, dt$$

$$= i_L \frac{n_3}{n_1} d_1 + \underbrace{d_1 i_{Lm} - d_2 i_{Lm}}_{\to 0}$$

$$= \frac{n_3}{n_1} I_L D + \frac{n_3}{n_1}\hat{i}_L D + \frac{n_3}{n_1} I_L \hat{d}$$

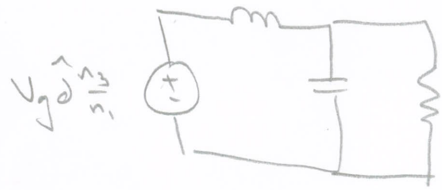


$$G_{vg} = \frac{\hat{v}}{\hat{v}_g}\Bigg|_{\hat{d}=0}$$



$$\hat{v} = \hat{v}_g D \frac{n_3}{n_1} \frac{1}{sL+\left(sC+\frac{1}{R}\right)^{-1}} \cdot \left(sC+\frac{1}{R}\right)^{-1} \Rightarrow \frac{\hat{v}}{\hat{v}_g} = D\frac{n_3}{n_1}\frac{1}{s^2LC+\frac{sL}{R}+1}$$

$$G_{vd}(s) = \frac{\hat{v}}{\hat{d}}\Bigg|_{\hat{v}_g=0}$$



$$\frac{v}{d} = V_g \frac{n_3}{n_1}\frac{1}{s^2LC+\frac{sL}{R}+1}$$