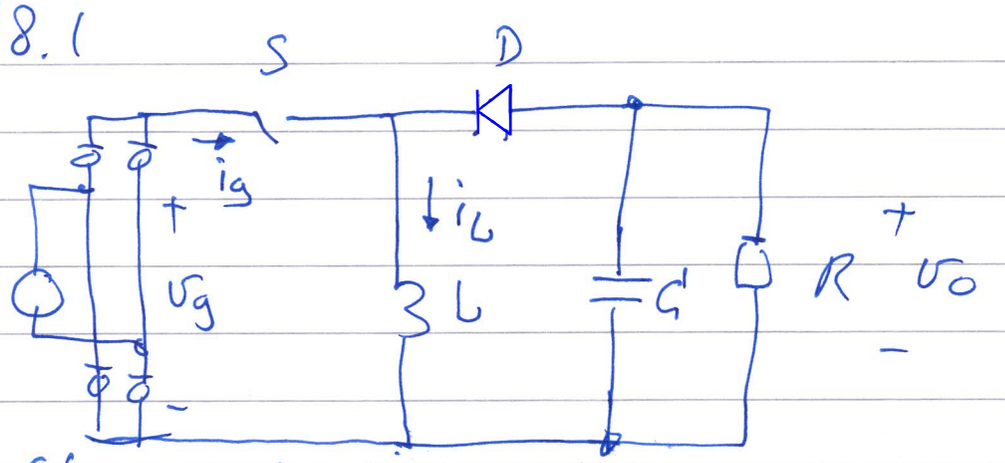
18.1



a) (find $d, \langle i_L \rangle_{T_S}$)

$$\frac{\langle v_o \rangle_{T_S}}{\langle v_g \rangle_{T_S}} = -\frac{d}{d'} \Rightarrow d = \frac{V_o}{V_o - \hat{V}_{ac}|\sin\omega t|}$$

$$d = \frac{1}{1 - \frac{\hat{V}_{ac}}{V_o}|\sin\omega t|}$$

$$\left.\begin{aligned} \langle i_g \rangle_{T_S} &= d\langle i_L \rangle_{T_S} \\ R_e &= \frac{\langle v_g \rangle_{T_S}}{\langle i_g \rangle_{T_S}} \end{aligned}\right\} \langle i_L \rangle_{T_S} = \frac{\langle i_g \rangle}{d}$$

$$\langle i_L \rangle_{T_S} = \frac{\langle v_g \rangle_{T_S}}{R_e d}$$

$$\langle i_L \rangle_{T_S} = \hat{V}_{ac}|\sin\omega t| \cdot \frac{1}{\left(1 - \frac{\hat{V}_{ac}}{V_o}|\sin\omega t|\right) R_e}$$

$$\langle i_L \rangle_{T_S} = \hat{V}_{ac}|\sin\omega t|\left(1 - \frac{\hat{V}_{ac}}{V_o}|\sin\omega t|\right)\frac{1}{R_e}$$

b: For CCM is required.

$$\langle i_L \rangle_{T_S} > \Delta i_L$$

$$\Delta i_L = \frac{\langle v_g \rangle_{T_S} \cdot T_S d}{2L}$$

$$\langle i_L \rangle_{T_S} = \frac{\langle v_g \rangle_{T_S}}{R_e d}$$

So

$$\frac{\langle v_g \rangle_{T_S}}{R_e d} > \frac{\langle v_g \rangle_{T_S} \cdot T_S d}{2L}$$

$$\frac{1}{R_e \cdot d} > \frac{d T_S}{2L}$$

$$R_e < \frac{1}{d^2} \frac{1}{T_S} 2L$$

$$d = \frac{V_o}{V_o - V_g}$$

$$\underline{\underline{R_e < \left(\frac{V_o - V_g}{V_o}\right)^2 \frac{2L}{T_S}}}$$

$$\frac{V_o}{V_g} = -\frac{d}{1-d}$$

$$\frac{V_o}{V_g}(1-d) = d$$

$$\frac{V_o}{V_g} - \frac{V_o}{V_g} d = -d$$

$$\frac{V_o}{V_g} = \left(\frac{V_o}{V_g} - 1\right) d$$

$$1 = \left(1 - \frac{V_g}{V_o}\right) d$$

$$1 = \frac{V_o - V_g}{V_o} d$$

c)

Minimum $R_{e\,crit}$ at $v_g = 0$

So $R_e < \frac{2L}{T_S} \Rightarrow$ CCM

Maximum $R_{e\,crit}$ at $v_g = \hat{V}_{ac}$

$$R_e = \left(\frac{V_o - \hat{V}_{ac}}{\hat{V}_{ac}}\right)^2 \frac{2L}{T_S}$$

d)

$$R_{e\,max} = \frac{132^2}{10} = 1742\ \Omega$$

$$R_{e\,min} = \frac{108^2}{100} = 117\ \Omega$$

So ccm is obtained for:

$$L > R_e \frac{T_s}{2}$$

$$L > \frac{1742 \cdot \frac{1}{75e3}}{2} \Rightarrow \underline{L > 12\,mH}$$

So Dcm is obtained for:

$$L < \frac{R_e T_s}{2} \left(\frac{\hat{V}_{ac}}{V_o - \hat{V}_{ac}} \right)^2$$

$$L < \frac{117 \cdot \frac{1}{75e3}}{2 \left(\frac{108}{-120-108} \right)^2}$$

$$\underline{L < 125\,\mu H \text{ at } 100W \text{ \& } 108V}$$