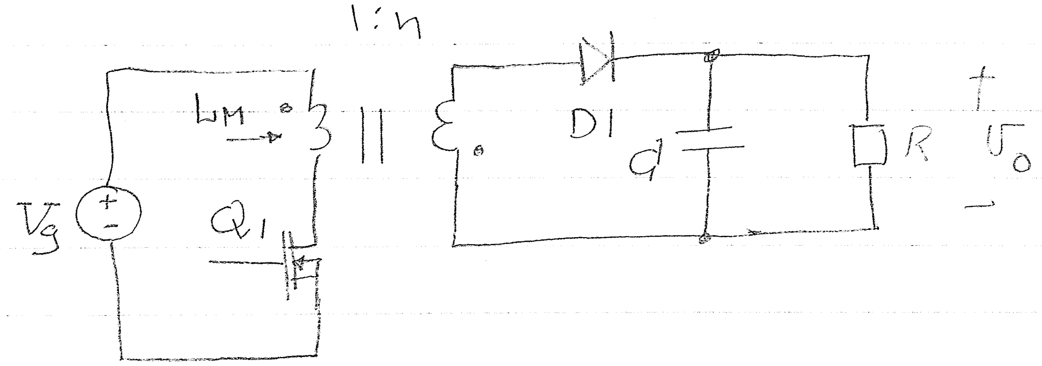
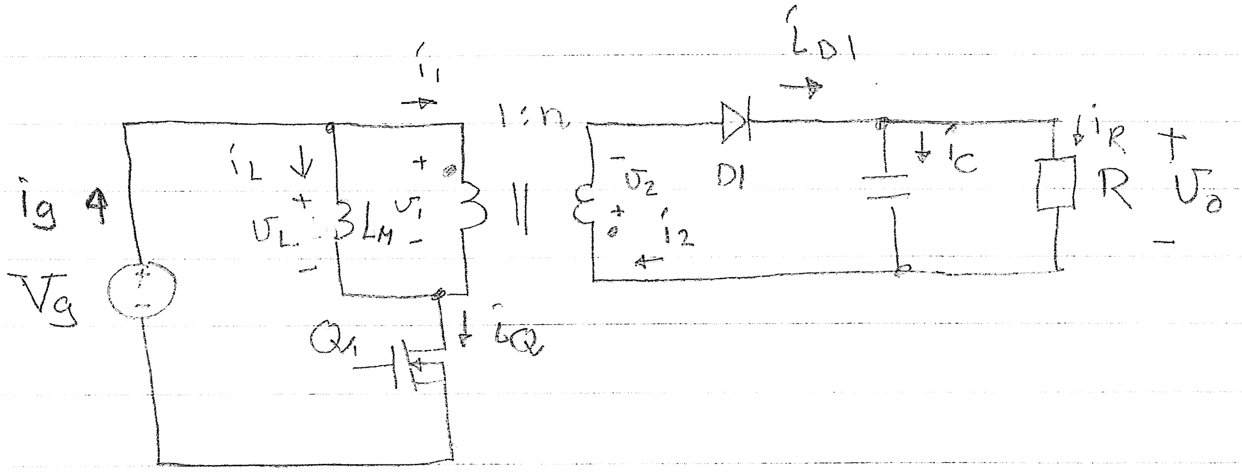
Problem 6.2 (b)+(a)

Fig6.30 (d)

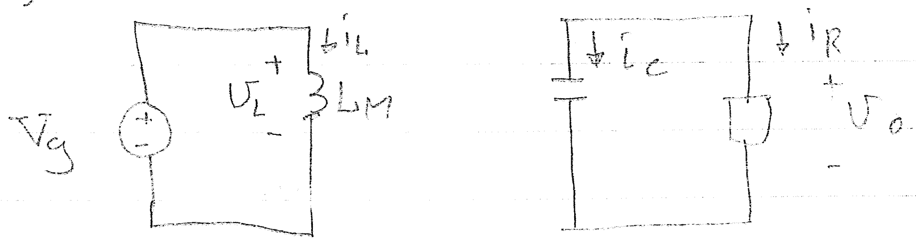


(a)

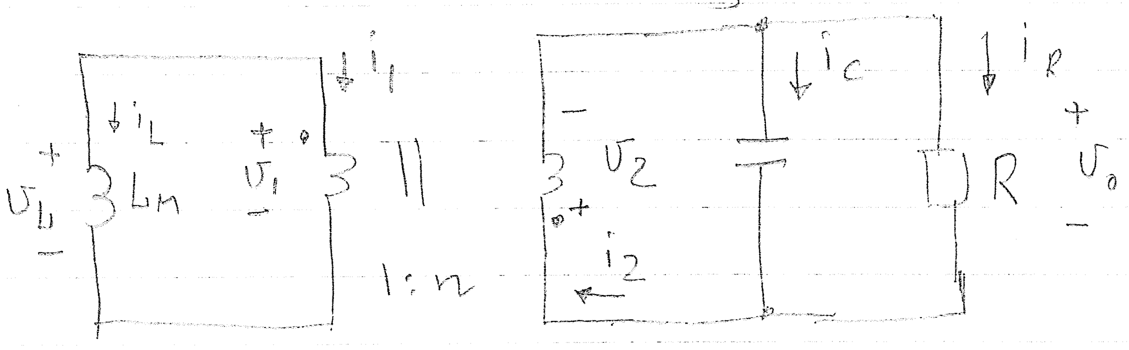


<u>subintervals</u> (show elements conducting current)

1) Q_1 = ON - conducting

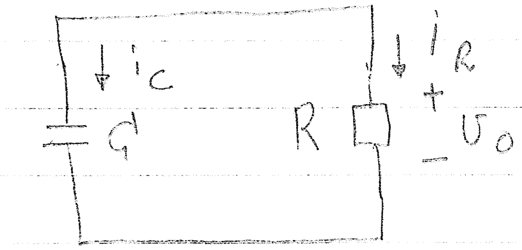


2) Q_1 = OFF D1 = ON conducting

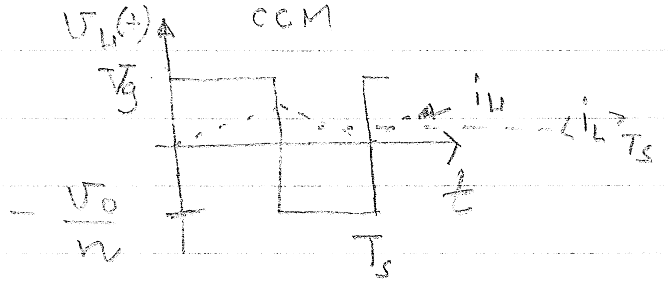


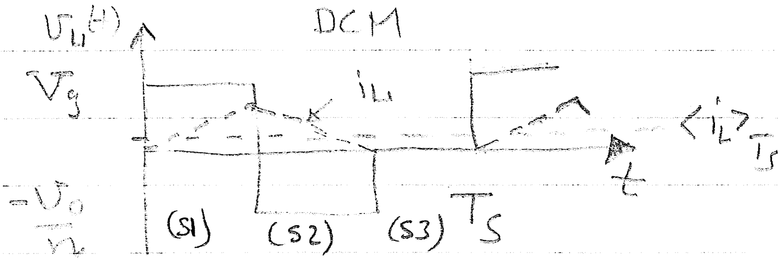
P6.2 (b)

3) Q_1 = OFF $D1$ = OFF



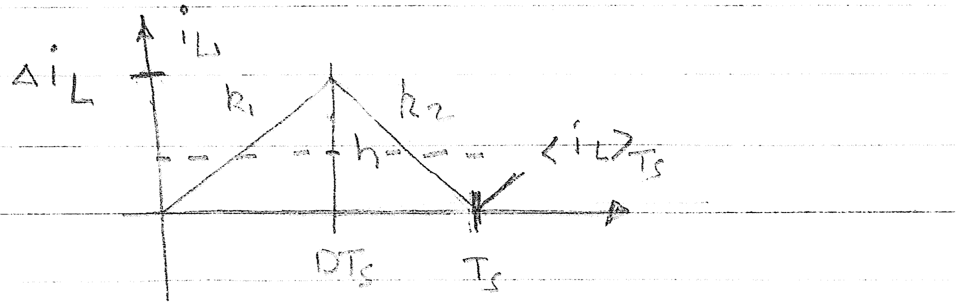
(b) CONDITION FOR DCM





n_1	n_2
1	$\frac{n_2}{n_1}$
1	n

$\Rightarrow n = \frac{n_2}{n_1}$



AT LIMIT OF DCM and CCM

is $\langle i_L \rangle_{T_S} = \frac{1}{2} \Delta i_L$

IN DCM $\boxed{\langle i_L \rangle_{T_S} < \frac{1}{2} \Delta i_L}$

$\Delta i = \frac{V_g}{L_M} D T_S$

$\Delta i = -k_2 (1-D) T_S$

i_L and i_R are connected

$i_1 = -i_2 n$

$\langle i_R \rangle_{T_S} = \frac{\langle v_0 \rangle_{T_S}}{R}$

$\langle i_1 \rangle_{T_S} = -\langle i_2 \rangle_{T_S} n$

$\langle i_2 \rangle_{T_S} = \frac{\langle v_0 \rangle_{T_S}}{R} + C \frac{d \langle v_0 \rangle_{T_S}}{dt}$

P6.2 (b)

$$\langle i_1\rangle_{T_s} = -n\frac{\langle v_0\rangle_{T_s}}{R} - nC\frac{d\langle v_0\rangle_{T_s}}{dt}$$

IDEAL TRANSFORMER

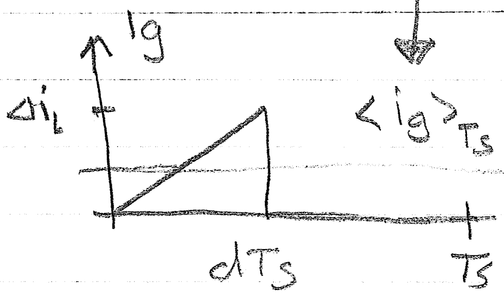
$$i_1 n_1 + i_2 n_2 = 0$$

$$i_1 = -i_2 n$$

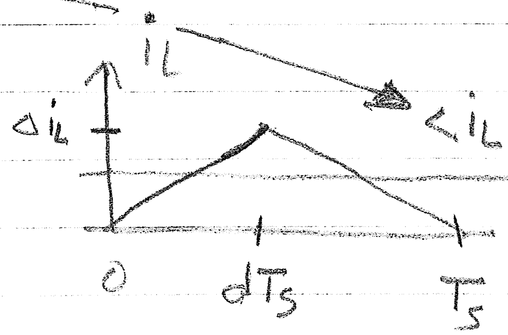
$$\langle i_1\rangle_{T_s} = -\langle i_2\rangle_{T_s} n$$

From input side:

$$\langle i_g\rangle_{T_s} - \langle i_L\rangle_{T_s} - \langle i_1\rangle_{T_s} = 0$$



$$\langle i_g\rangle_{T_s} = \langle i_L\rangle_{T_s} d$$



$\langle i_L\rangle_{T_s}$

COLLECT

$$0 = \langle i_L\rangle_{T_s} d - \langle i_L\rangle_{T_s} + n\frac{\langle v_0\rangle_{T_s}}{R} + nC\frac{d\langle v_0\rangle_{T_s}}{dt}$$

$$\langle i_L\rangle_{T_s} = \frac{n\frac{\langle v_0\rangle_{T_s}}{R} + nC\frac{d\langle v_0\rangle}{dt}}{(1-d)}$$

And

$$\Delta i_L = \frac{V_g}{L} dT_s$$

$\langle i_L\rangle_{T_s} < \frac{1}{2}\Delta i_L$

P6.2 (b)

SO - FOR DCM

$$\frac{n\frac{\langle v_o\rangle_{T_s}}{R} + nC\frac{d\langle v_o\rangle_{T_s}}{dt}}{1-d} < \frac{1}{2}\frac{V_d}{L}dT_s$$

$$\langle v_o\rangle_{T_s} < \frac{V_d R(1-d)dT_s}{2Ln} - RC\frac{d\langle v_o\rangle_{T_s}}{dt}$$

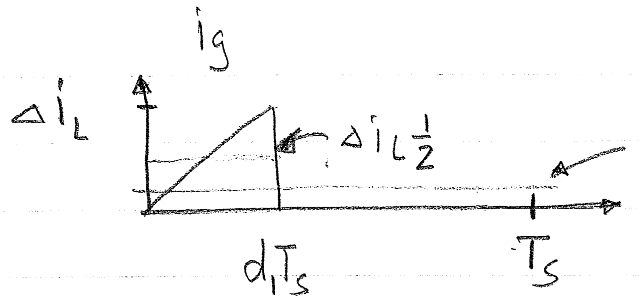
OR

$$\langle i_o\rangle_{T_s} < \frac{V_d(1-d)dT_s}{2Ln} - C\frac{d\langle v_o\rangle_{T_s}}{dt}$$

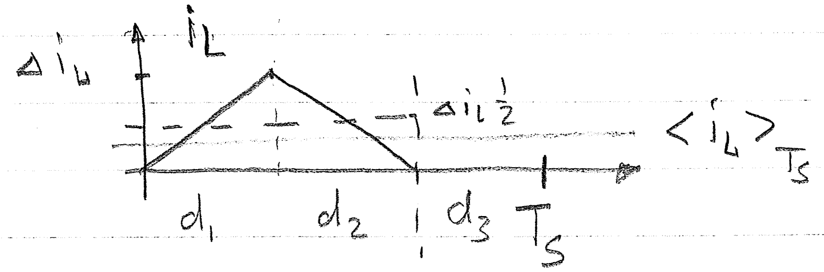
In steady-state

$$I_o < \frac{V_d(1-D)DT_s}{2Ln}$$

P.6.2 (c)



$d_1 \frac{1}{2} \Delta i_L = \langle i_g \rangle_{T_s}$



$\langle i_L \rangle_{T_s} = (d_1 + d_2) \frac{1}{2} \Delta i_L \qquad d_1 + d_2 + d_3 = 1$

$- \langle i_L \rangle_{T_s} - \langle i_1 \rangle_{T_s} + \langle i_g \rangle_{T_s} = 0$ Front side

$\langle i_1 \rangle_{T_s} = d_1 \frac{1}{2} \Delta i_L - (d_1 + d_2) \frac{1}{2} \Delta i_L$

$\langle i_1 \rangle_{T_s} = -d_2 \frac{1}{2} \Delta i_L$ ← YES :-)

$\langle i_2 \rangle_{T_s} = - \langle i_1 \rangle_{T_s} / n$

$\langle i_2 \rangle_{T_s} = \frac{1}{n} d_2 \frac{1}{2} \Delta i_L$

P.6.2 (c)

IN STEADY STATE V_o = CONSTANT

SO $I_c = 0$

THUS

$$I_2 = \frac{1}{n} D_2 \frac{1}{2} \Delta i_L$$

$$V_o = I_2 R$$

$$V_o = \frac{1}{n} R D_2 \frac{1}{2} \Delta i_L$$

$$V_o = \frac{1}{n} R D_2 \frac{V_g}{2L} D_1 T_s$$

$$D_2 = \frac{V_o 2 L n}{R V_g D_1 T_s}$$

ABOVE IS V_o UNKNOWN

SO WE ARE NOT ABLE

TO CALCULATE D_2

NEED ANOTHER EQUATION:

P. 6.2 (c)

IN SS. IS AVERAGE VOLTAGE OF $L_M = 0$.

$$\underline{0 = V_g D_1 - \frac{V_o}{n} D_2}$$

: INTEGRATING VOLTAGE OF U_{LM} AND MULTEPLY WITH $\frac{1}{T_S}$ = AVERAGE VOLTAGE

$$0 = V_g D_1 - \frac{V_o}{\cancel{n}} \frac{V_o \cancel{n} 2L}{R V_g D_1 T_s}$$

$$0 = V_g D_1 - \frac{V_o^2 2L}{R V_g D_1 T_s}$$

$$0 = V_g^2 D_1 - \frac{V_o^2 2L}{\cancel{R D_1 T_s}}$$

$$V_g^2 D_1^2 = \frac{V_o^2 2L}{R T_s}$$

$$\left(\frac{V_o}{V_g}\right)^2 = D_1^2 \frac{R T_s}{2L}$$

$$\underline{\underline{\frac{V_o}{V_g} = D_1 \sqrt{\frac{R T_s}{2L}}}}$$

STEADY STATE

P6.2.(c)

WE KNOW FROM PAGE 6

$$D_2 = \frac{V_o\, 2 L n}{R V_g D_1 T_s} \quad \text{and} \quad V_o = V_g D_1 \sqrt{\frac{R T_s}{2L}}$$

SO

$$D_2 = \frac{\cancel{V_g}\cancel{D_1}\sqrt{\frac{R T_s}{2L}}}{R \cancel{V_g} \cancel{D_1} T_s}$$

$$D_2 = \frac{1}{R T_s}\sqrt{\frac{R T_s}{2L}}$$

$$D_2 = \sqrt{\frac{R T_s}{2L}\frac{1}{R^2 T_s{}^2}}$$

$$D_2 = \sqrt{\frac{1}{2 L R T_s}}$$