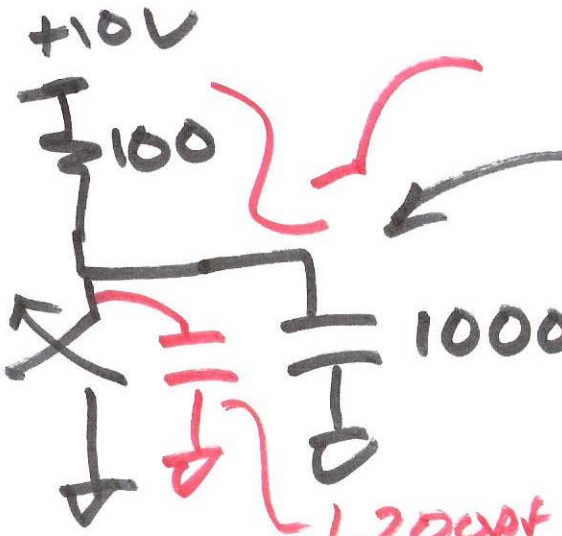
ECE 5/472 Power Electronics

BOISE STATE UNIVERSITY

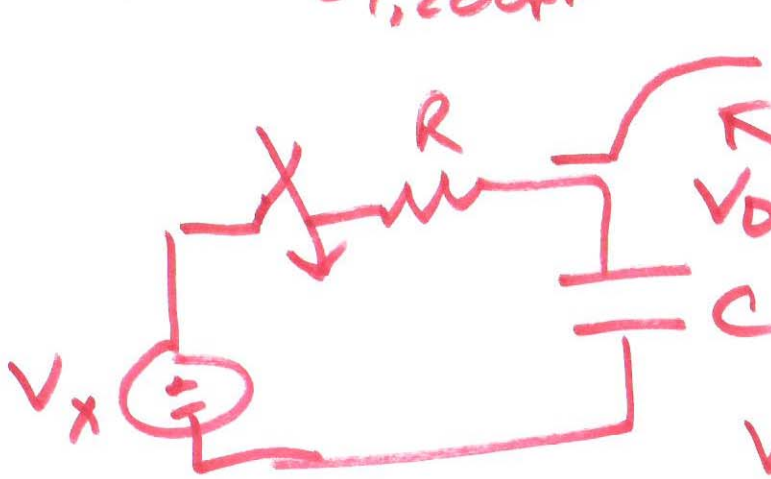
Lecture 3 Aug. 30, 2011



$t_r = 2.2RC$

$= 220\,ns$

Sim → $t_r = 500ns$



$$V_o = V_x\left(1 - e^{-t/RC}\right)$$

90% − 10%

$V_x \cdot .9 - V_x \cdot .1$

$$V_x \cdot (0.9) - V_x(0.1) = V_x\left(1 - e^{-t_{90\%}/RC}\right) - V_x\left(1 - e^{-t_{10\%}/RC}\right)$$

1)

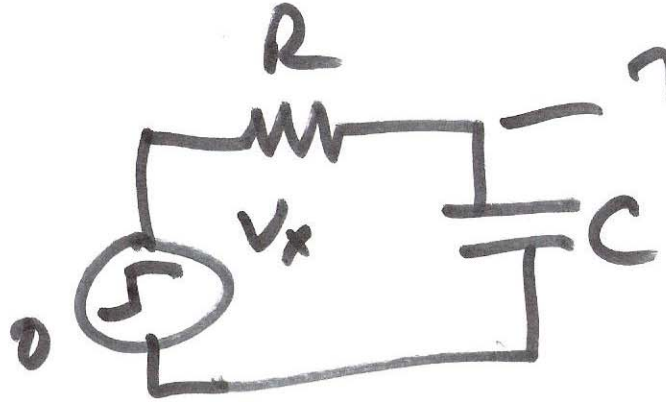
$$0.8 = -e^{-t_{10\%}/RC} + e^{-t_{10\%}/RC}$$

$$\ln .8 = \ln\left(e^{-t_{90\%}/RC} - e^{-t_{10\%}/RC}\right)$$

$$\ln\left(\frac{a}{b}\right) = \frac{\ln a}{\ln b} = \ln a - \ln b$$

$$\ln a \cdot b = \ln a + \ln b$$

2)



$$v_o(t) = V_x\left(1 - e^{-t/RC}\right)$$

$$t_{90\%} - t_{10\%} = t_{rise\,time} = \underline{2.2RC}$$

$$0.9V_x = V_x\left(1 - e^{-t_{90}/RC}\right)$$

$$0.1V_x = V_x\left(1 - e^{-t_{10}/RC}\right) \quad -2.3$$

$$+0.1 = e^{-t_{90\%}/RC} \rightarrow t_{90\%} = (\ln .1)\,RC$$

3) $$+0.9 = e^{-t_{10\%}/RC} \rightarrow t_{10\%} = (\ln .9)\,RC$$

Buck Converter

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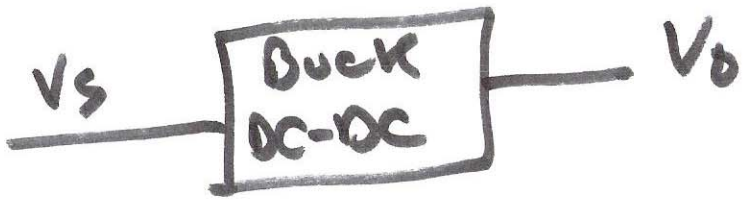
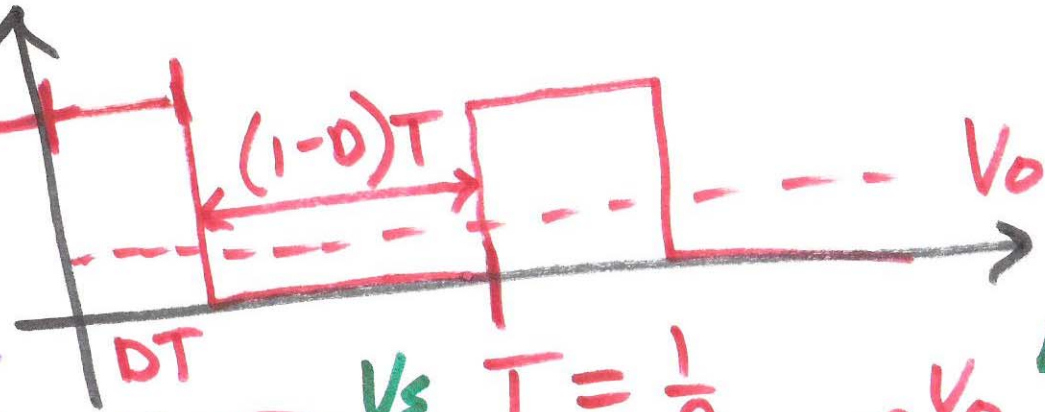
$L \cdot \frac{di}{dT} = V$



$V_s > V_o$

$V_o = D \cdot V_s$



$\frac{V_s - V_o}{L} = \frac{di}{dT}$

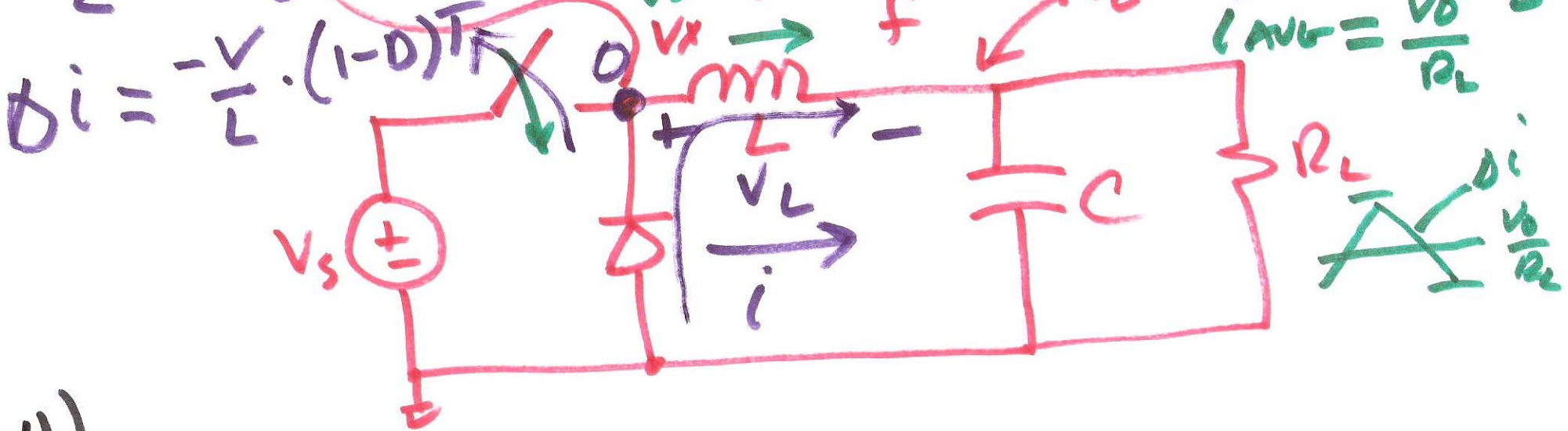
$\frac{0 - V}{L} = \frac{di}{dT}$

$\Delta i = DT \cdot \frac{(V_s - V_o)}{L}$

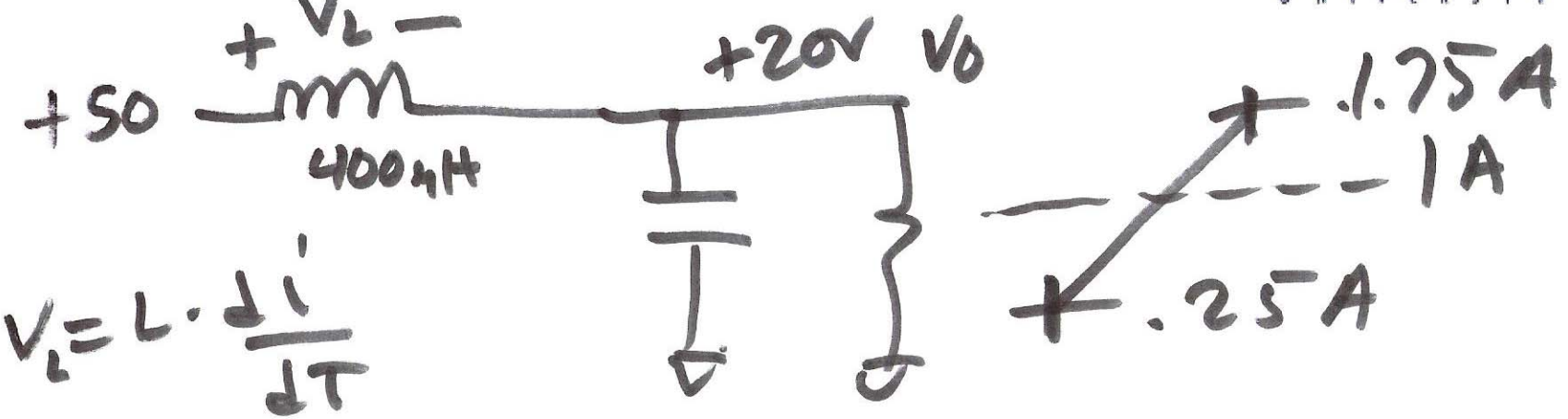
$\Delta i = \frac{-V}{L} \cdot (1-D)T$

$V_s \quad T = \frac{1}{f}$

$i_{AVG} = \frac{V_o}{R_L}$



4)



$$V_L = L \cdot \frac{di}{dT}$$

$$\frac{V_L - V_O}{L} = \frac{di}{dT}$$

$$\frac{50 - 20}{400\mu} = \frac{di}{dT}$$

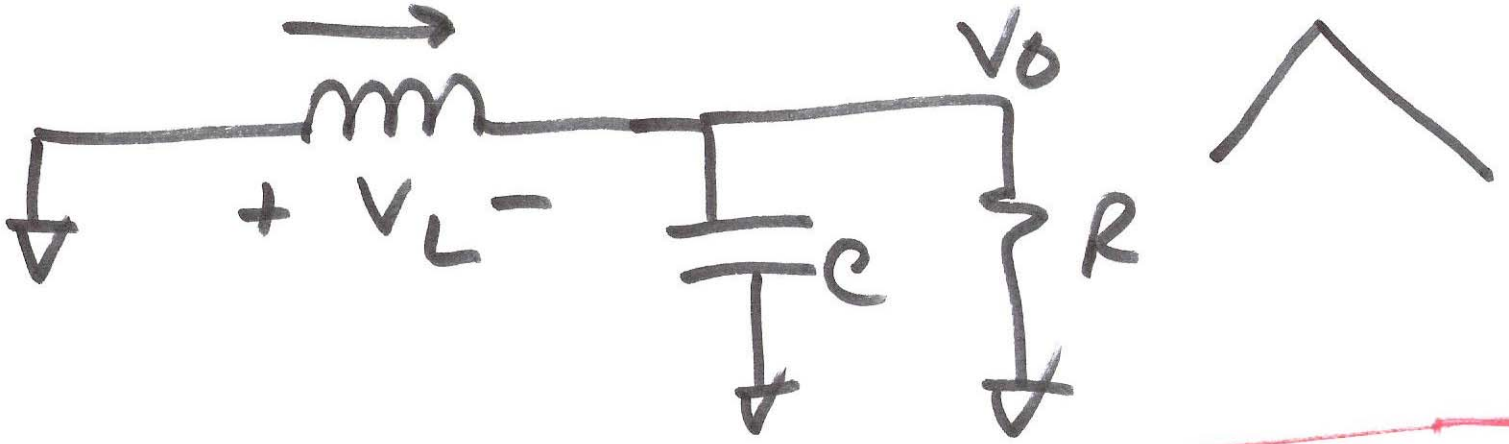
$$\frac{di}{dT} = \frac{1.5A}{20\mu}$$

$$\Delta i \Rightarrow \Delta i = \frac{V_S - V_O}{L} \cdot \frac{D}{f}$$

$$\Delta T = D/f = \frac{30}{400\mu} \cdot \frac{.4}{20K}$$

$$= \frac{12}{8} = \frac{3}{2} = 1.5A$$

5)



$$\frac{0 - V_o}{L} = \frac{di}{dT} \Rightarrow \boxed{\Delta i = \frac{-V_o}{L}\left(\frac{1-D}{f}\right)}$$

$$\Delta i = \frac{-20}{400\mu} \cdot \frac{0.6}{20K} = \frac{-12}{8} = -1.5A$$

$$\frac{di}{dT} = \frac{-1.5\,A}{30\mu}$$

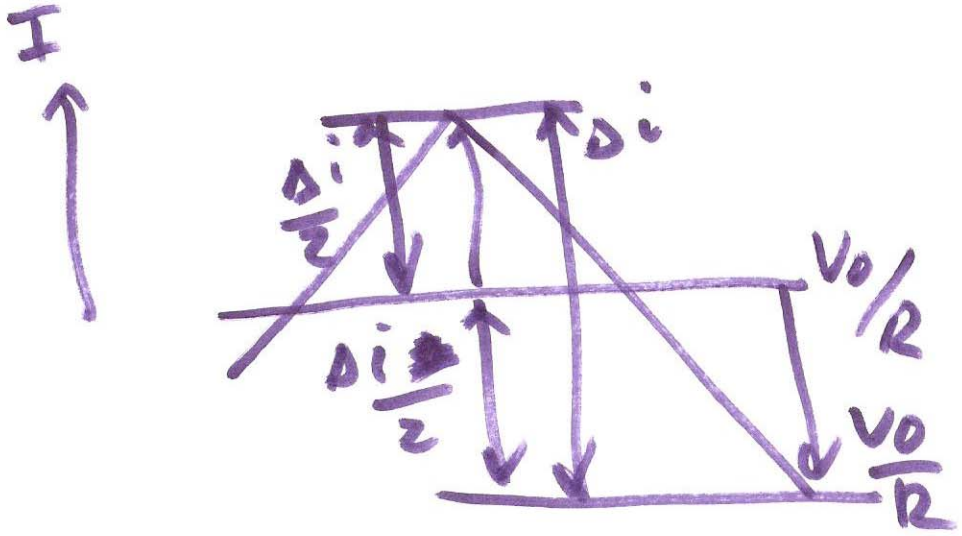
6)

$$\frac{V_s - V_o}{L} \cdot \frac{D}{f} - \frac{V_o}{L}\frac{(1-D)}{f} = 0$$

$$D(V_s - V_o) + DV_o - V_o = 0$$

$$\boxed{DV_s = V_o}$$

$$\frac{V_o}{R} = \frac{1}{2} D i_{\Delta} = \frac{V_s - V_o}{2 L_{min}} \cdot \frac{D}{f}$$



$$V_s \cdot D = V_o \qquad V_s = \frac{V_o}{D}$$

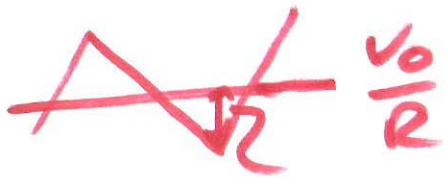
$$\frac{V_o}{R} = \frac{V_s - V_o}{2 L_{min}} \cdot \frac{D}{f}$$

$$\frac{1}{R} = \frac{1-D}{2 L_{min} f}$$

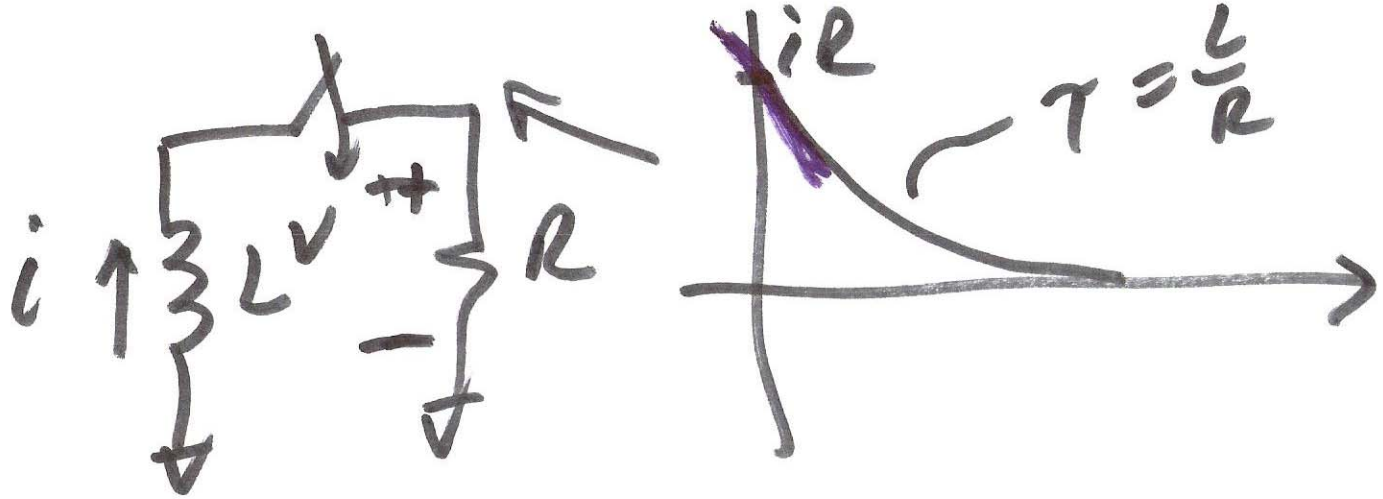
$V_o = V_s$

$$\frac{di}{dt} = \frac{V}{L}$$

$$L_{min} = \frac{R \cdot (1-D)}{2f}$$

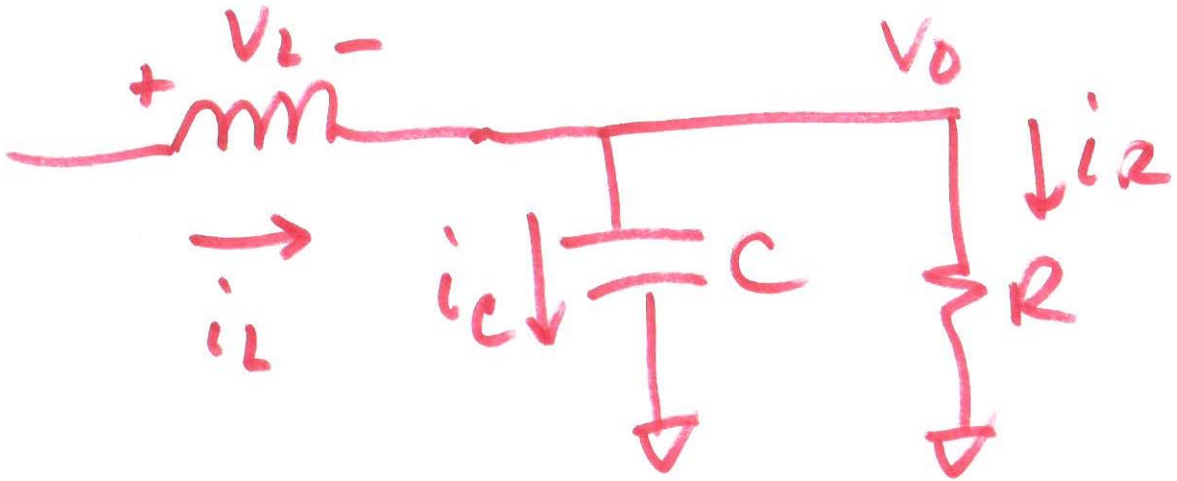


9)



$\frac{V}{L} = \frac{di}{dT}$ $\quad i^2R = P$

10)



$$i_C = i_L - i_R$$