ECE 320 & ECE 329

ENERGY SYSTEMS I

BACKGROUND STUDY IN ENERGY SYSTEMS

SESSION no. 31

DC / DC

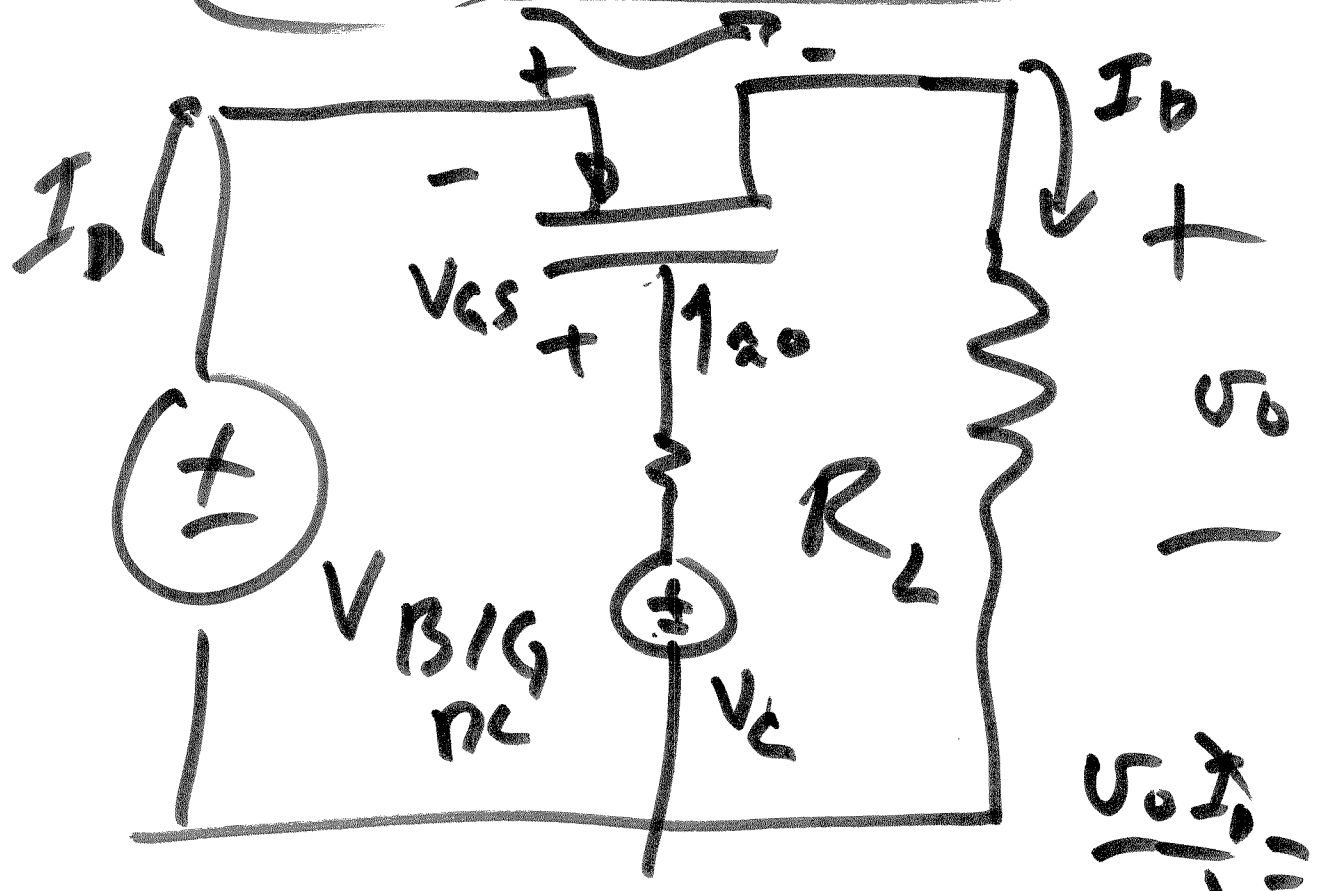
Down (Buck)

UP (Boost)

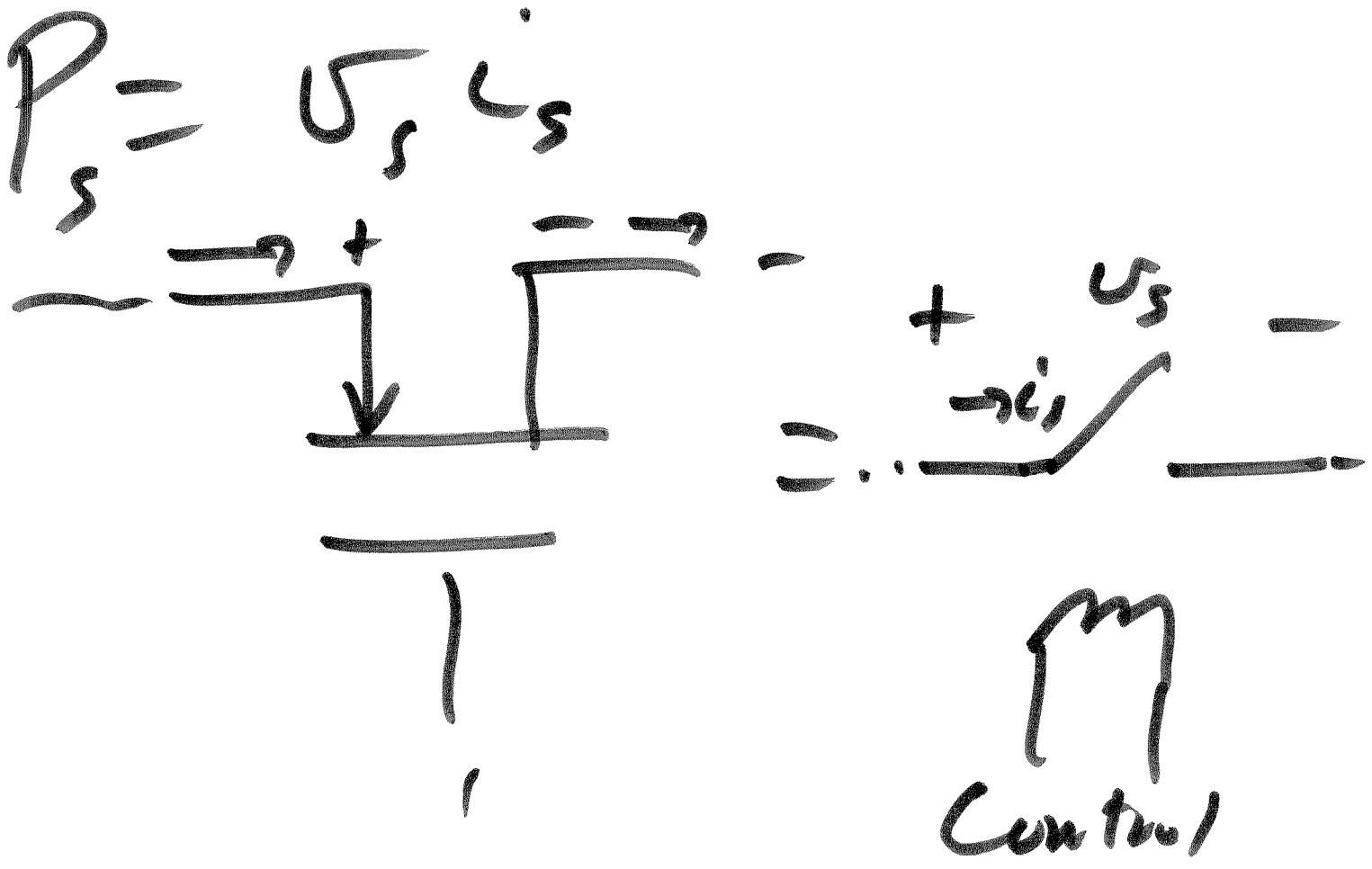
UP-Down (Buck-Boost)

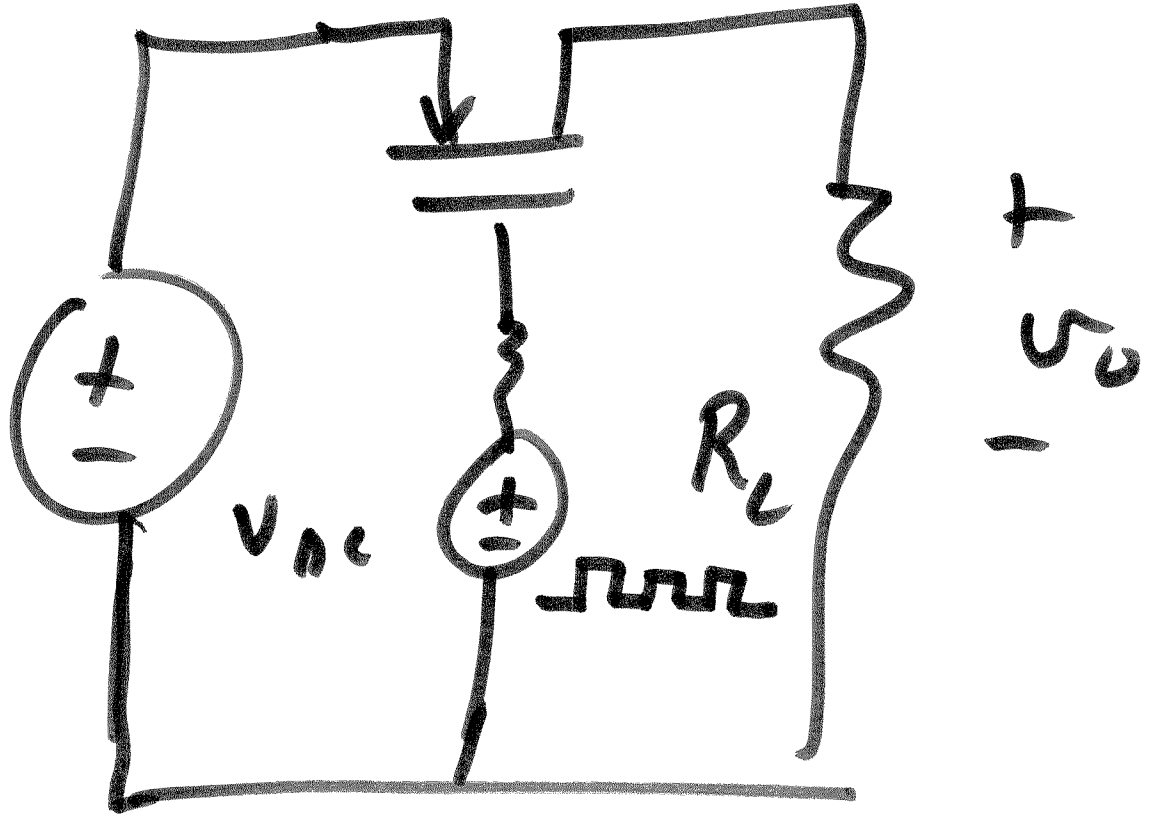
UP-Down (CUK)

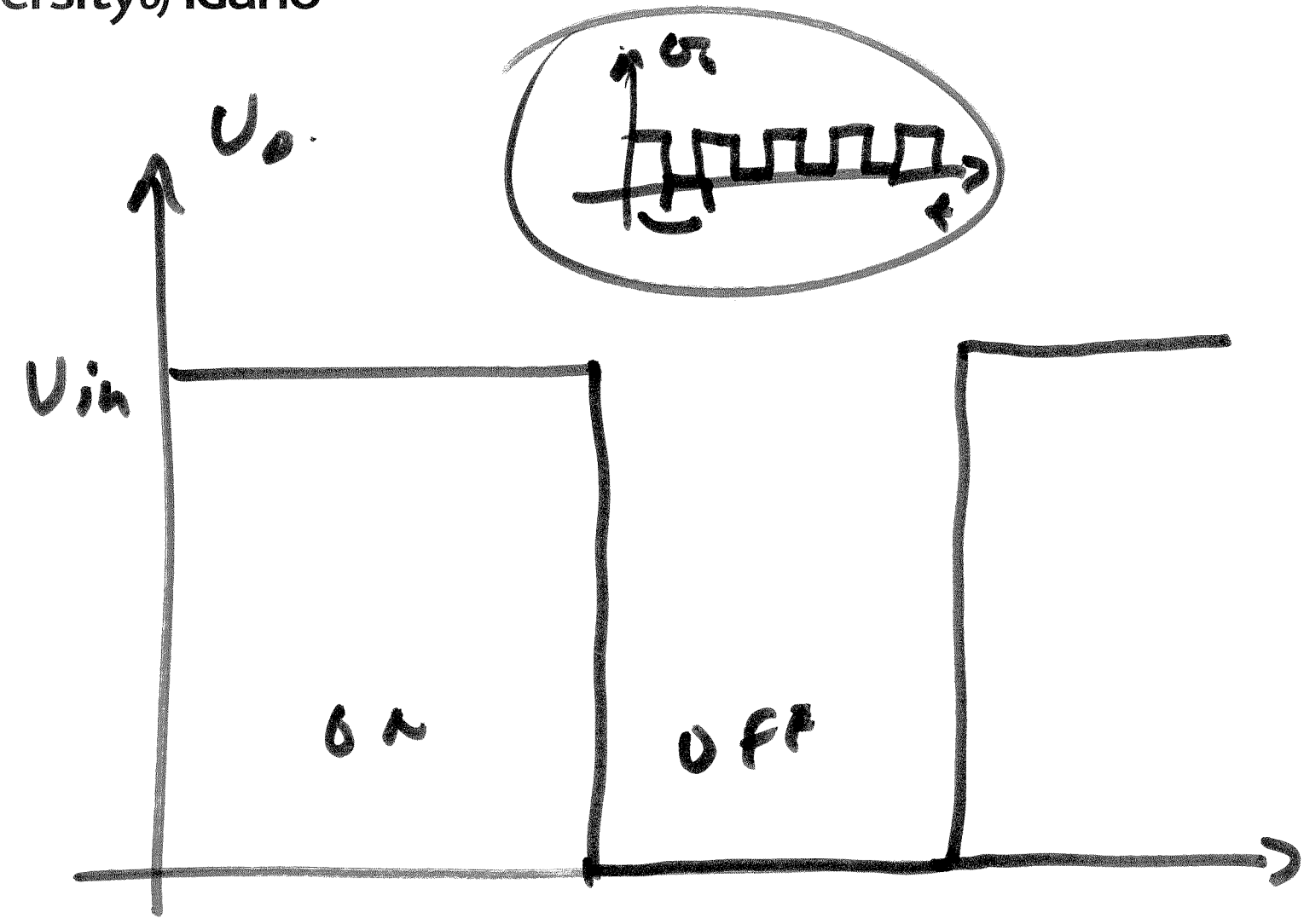
$$I_D = \frac{1}{2} \mu_n C_{ox} \frac{W}{L} (V_{GS} - V_t)^2$$

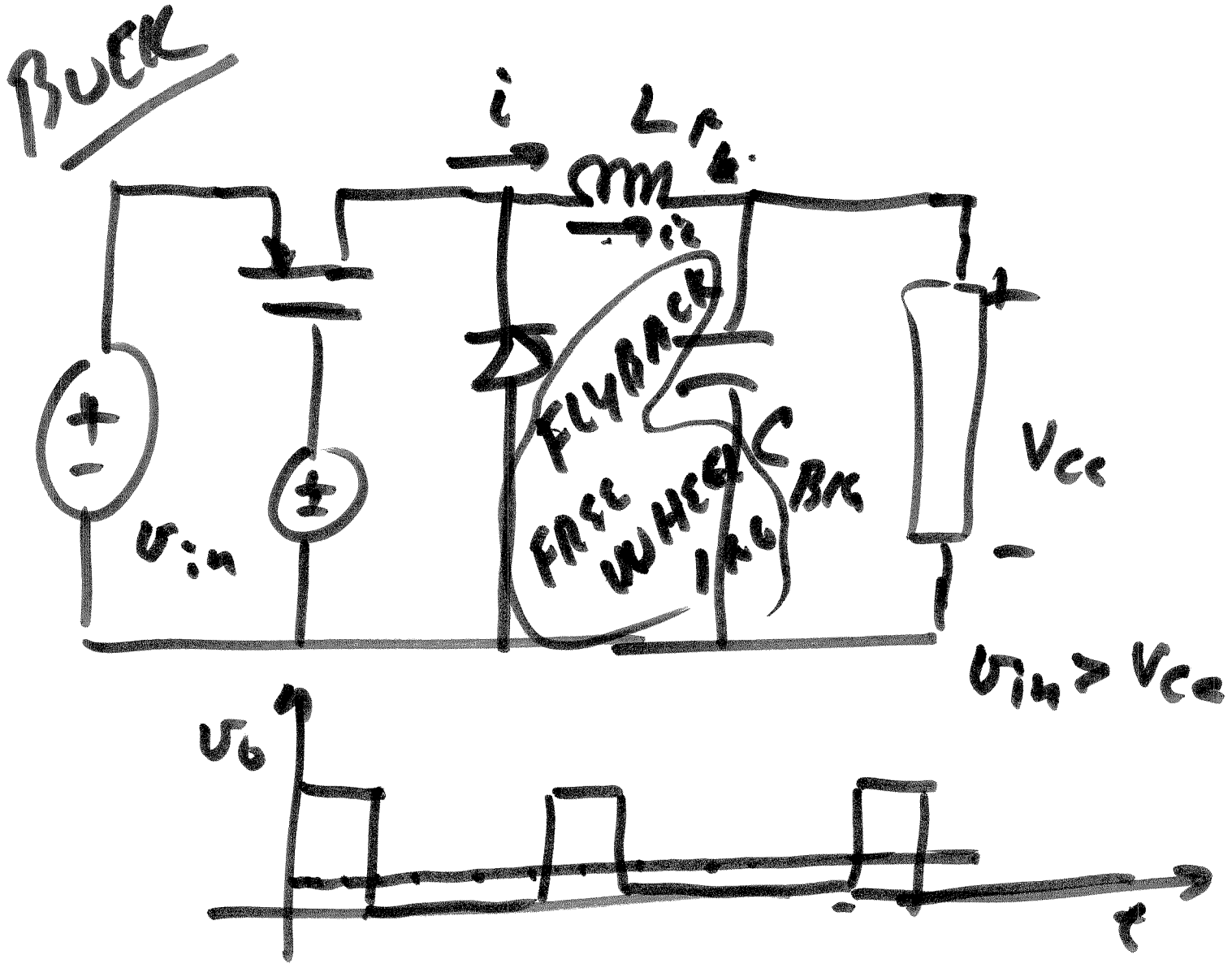


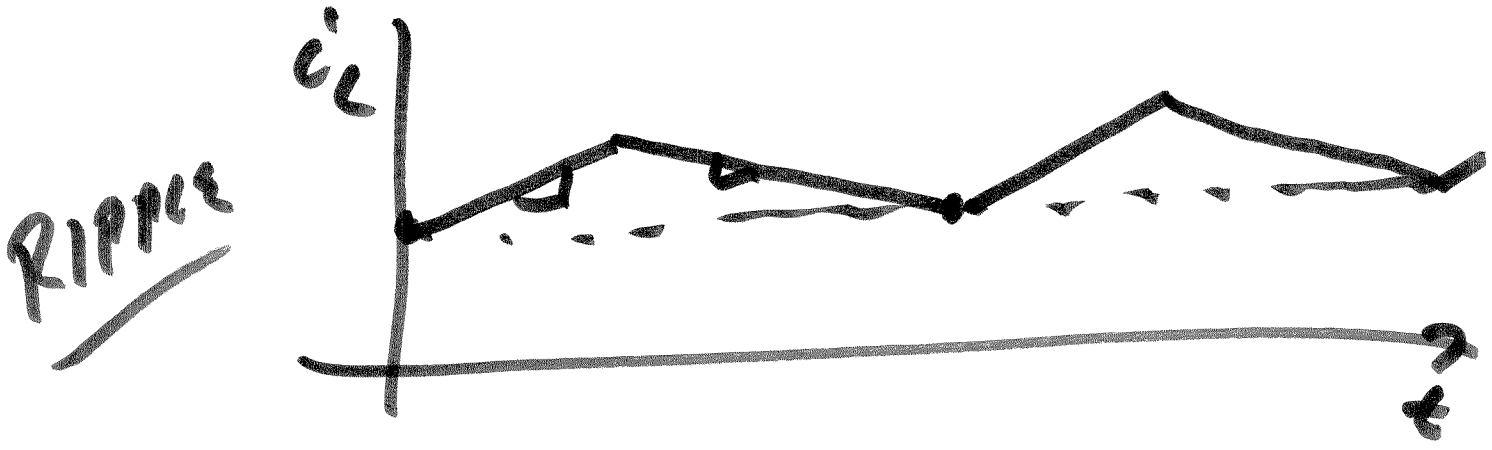
$$\frac{V_O I_D}{V_{BIG} I_D} = \frac{P_O}{P_{in}}$$


Control


+
V_{DC}
R_L
+
v_o
−


v_o
V_{in}
ON
OFF
v_o
t


Buck
i
L
SW
FLYBACK
FACE
WHEEL
DIO
BRK
Vcc
Vin
Vin > Vcc
Vb
t

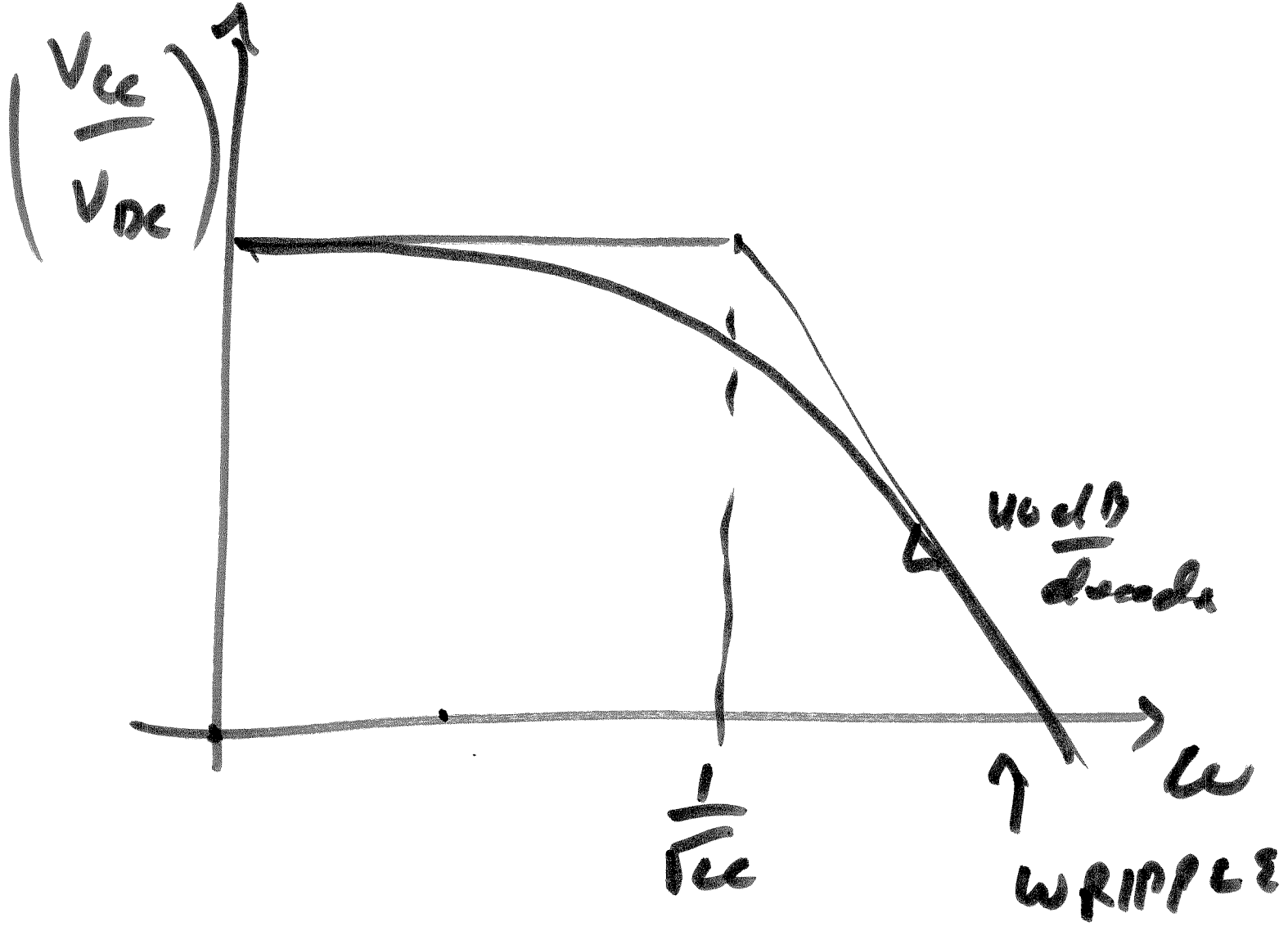


$$i_L = \int \frac{(V_{in} - V_{cc})}{L_F} dt$$

$$i_L = \int \frac{0 - V_{cc}}{L_F} dt$$

$$\frac{V_o}{V_{in}} = D$$

$$D = \frac{t_{on}}{T_{period}}$$


$\left(\frac{V_{cc}}{V_{DC}}\right)$
40 dB/decade
$\frac{1}{T_{cc}}$
ω
RIPPLE

Five Basic Laws of Power Electronic Circuits

1. Voltage across an inductor averages to zero for a complete cycle.
2. Current through a capacitor averages to zero for a complete cycle.
3. Inductor current is always continuous.
4. Capacitor voltage is always continuous.
5. Conservation of energy is always valid.

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Energy Systems I

Lesson 31

DC / DC Conversion

Voltage divider

☺ It works…

☺ It is simple…

☹ The efficiency is BAD…

Transistor…linear converter

☺It works!

☺ Easily variable

☹ The efficiency is BAD…

Switched …

If the switch is open, the switch consumes ZERO power (p=vi)

If the switch is closed, the switch consumes ZERO power (p=vi)

If I want to vary or control the output voltage, I switch at a different time interval.

Power electronics is the controlled, intelligent use of circuit transients to our advantage. We use switching circuits and filters.