Lecture 22 - MIDTERM II REVIEW SESSION

Administrivia

- NO OFFICE HOURS TONIGHT [H-W IS EASY ☺]
- MIDTERM II REVIEW PROBLEMS ETC. WILL BE UP BY TOMORROW (04/08/05)

MIDTERM II → "ORGANIZATION" SAME AS MIDTERM I.

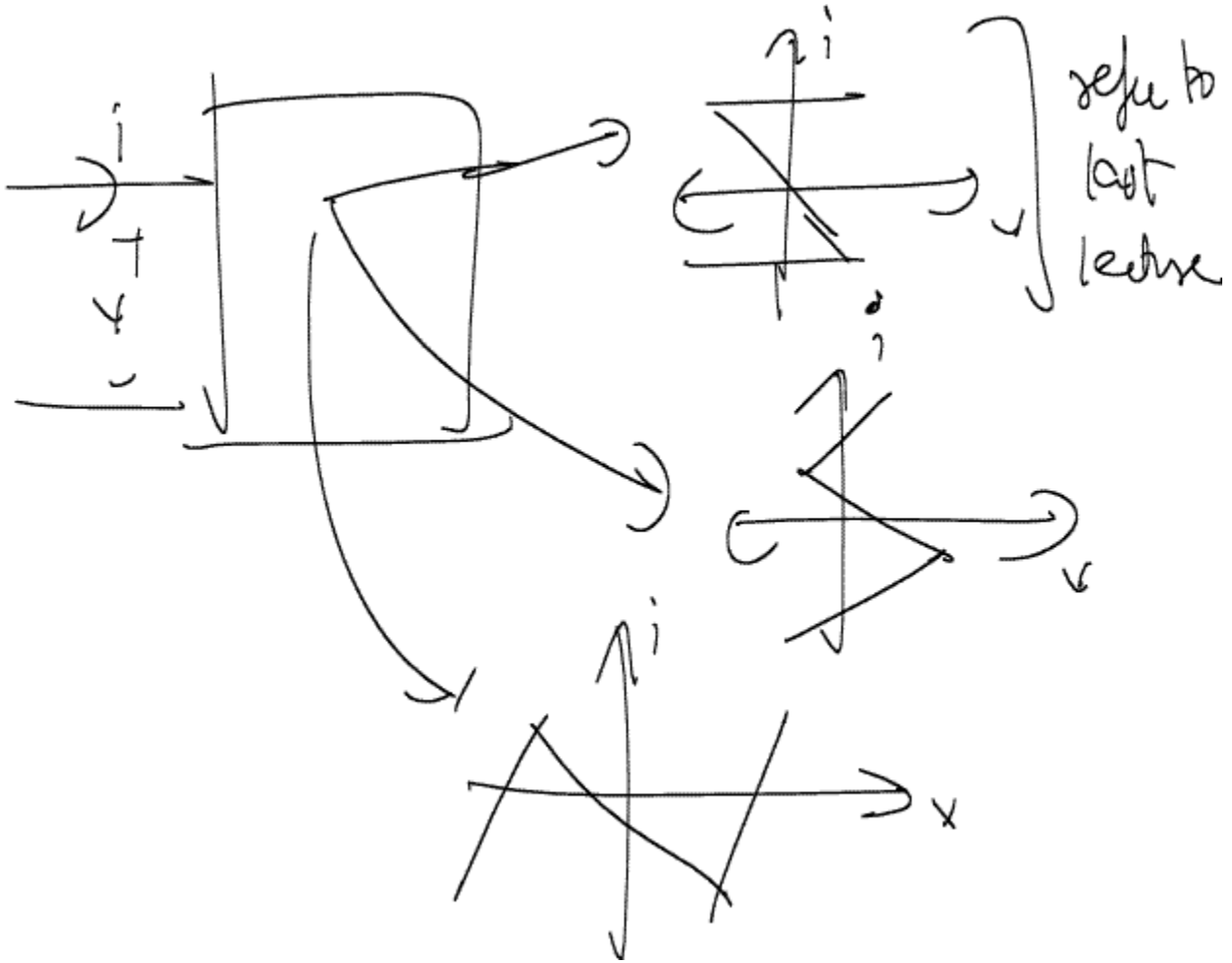
- Next Thursday (04/14)
  - 2:00 pm - 5:00 pm, "MAKEUP" 299 Cory
    - (POST ON NEWSGROUP IF YOU WANNA TAKE MAKEUP BY TOMORROW, (04/08), 5:00 pm, P.S.T)
  - 6:00 pm - 9:00 pm, 1 PM CENTRAL
- 4 problems, all op-amps.

4 problems

- (1) Opamp analysis (I) (like HW #7 i.e.. chapter 5 problems)
- (2) flip-flop (like HW #9 problem from reader, p-329)
- (3) Opamp analysis (II) (little more difficult than (I))
- (4) oscillator. (cc)

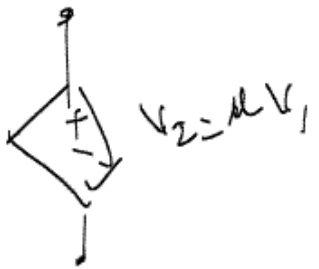
Note: (1) "nice numbers" → eg: 24.999999998 = 25
i.e.. calculator not required.

Note : (1)

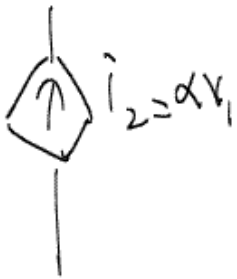


Ex: Modelling dependent sources using opamp:

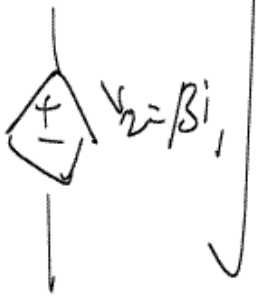
VCVS



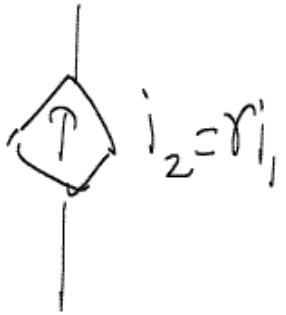
VCCS

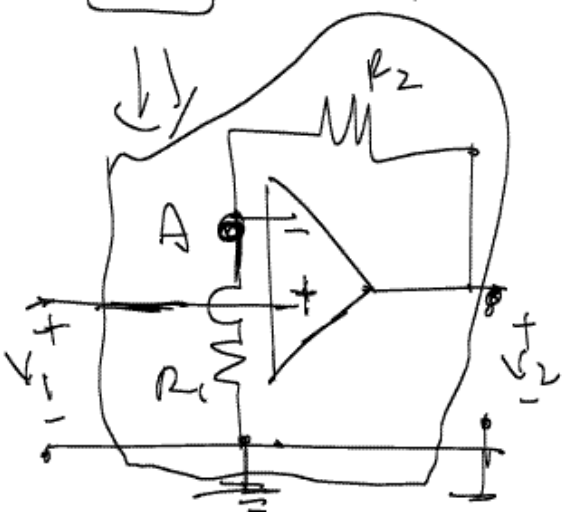


CCVS



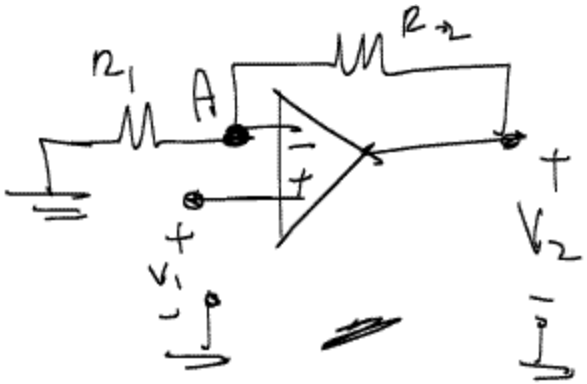
CCCS





VCVS

Notice:

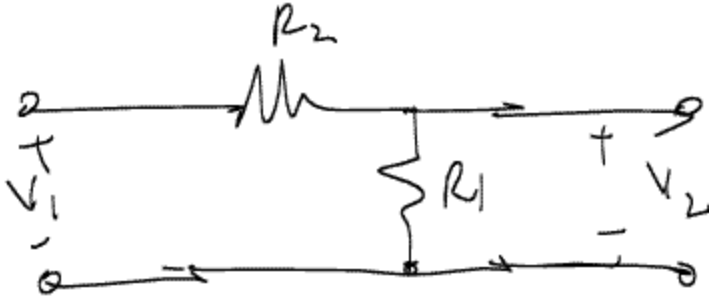


$$V_2 = \left(1 + \frac{R_2}{R_1}\right) V_1$$

u $\quad [u \geq 1]$

Non-inverting amplifier

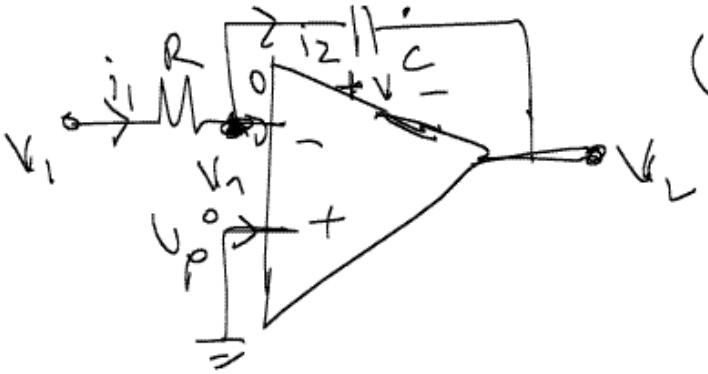
If we want $u < 1$



$$V_2 = \left(\frac{R_1}{R_1 + R_2}\right) V_1$$

$u_1 \quad u < 1$

Ex:



(Q:) Find $V_2 = f(V_1)$

[ignore rails, assume op-amp is always ideal]

Step (1): $V_p \simeq V_n$. $V_n = 0$ [since $V_p = 0$]

Step (2): KCL @ V_n:

$i_1 = i_2 \Rightarrow \quad \frac{V_1 - 0}{R} = i_2$

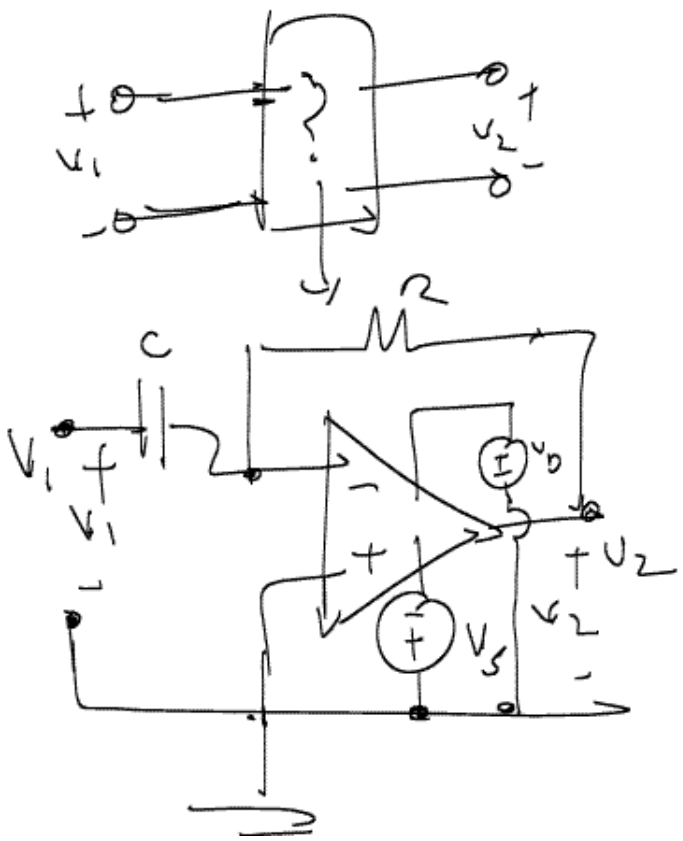
$i_2 = C\frac{dv}{dt}$ (v ∥ i_2, + on top plate)

$= C\frac{d(0 - V_2)}{dt}$

$\Rightarrow \boxed{i_2 = -C\frac{dV_2}{dt}}$

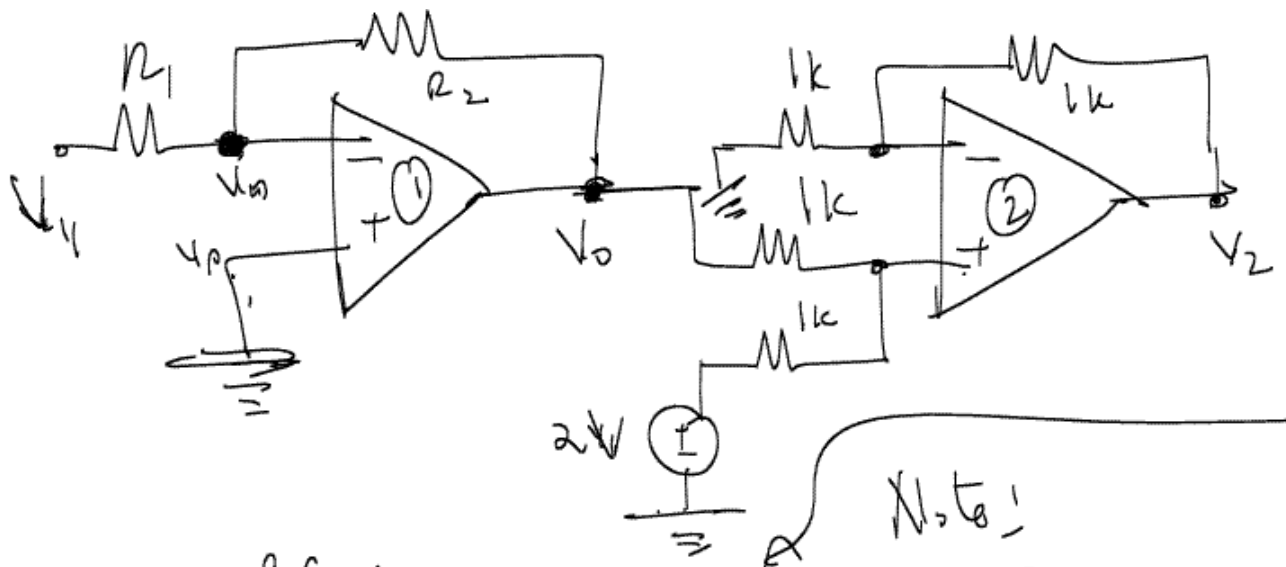
$$\frac{v_1}{R} = -C\frac{dv_2}{dt} \Rightarrow \boxed{v_2 = -\frac{1}{RC}\int v_1\,dt}$$

Ej:



$$v_2 = \beta\frac{dv_1}{dt}$$

Ex:



Find $V_2 = f(V_1)$

1st: ① ⇒ inverting amplifier

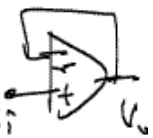
$$V_o = f(V_1) = -\frac{R_2}{R_1} V_1 \quad -①$$

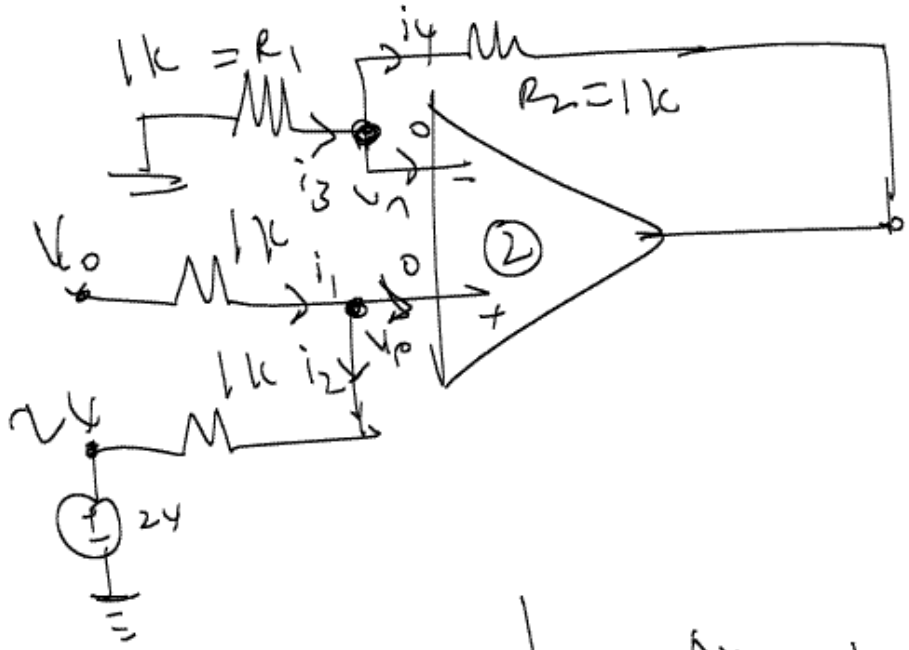
↳ derivation in book, previous lecture notes

Note:

On your cheat sheet

- ↳ voltage follower
- ↳ inverting amplifier
- ↳ non-inverting amplifier
- ↳ inverting summing amplifier. etc...





$V_2 = f(V_o)$

V_{o2}

Step ①: $V_p \simeq V_n$, here you have to find V_p.

KCL @ V_n: $i_3 = i_4$

$\Rightarrow \dfrac{0 - V_n}{1k} = \dfrac{V_n - V_2}{1k}$

Now KCL @ V_p: $i_1 = i_2$

$\Rightarrow \dfrac{V_o - V_p}{1k} = \dfrac{V_p - 2}{1k}$

$\Rightarrow V_o + 2 = 2V_p \Rightarrow \boxed{V_p = \dfrac{V_o + 2}{2}}$

$\downarrow$

$\Rightarrow -V_o = V_n - V_2$

$\Rightarrow V_2 = 2V_n = 2V_p = 2\left[\frac{V_o+2}{2}\right] \Rightarrow \boxed{V_2 = V_o + 2}$

$\therefore \; V_o = -\frac{R_2}{R_1} V_1$

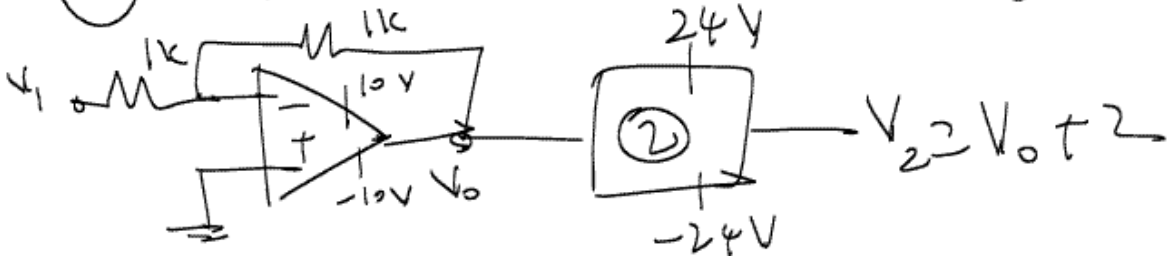
$V_2 = V_o + 2$

$\Rightarrow \boxed{V_2 = \frac{-R_2}{R_1} V_1 + 2}$

(2)

Notes: (1) Watch out for railing!

ex:



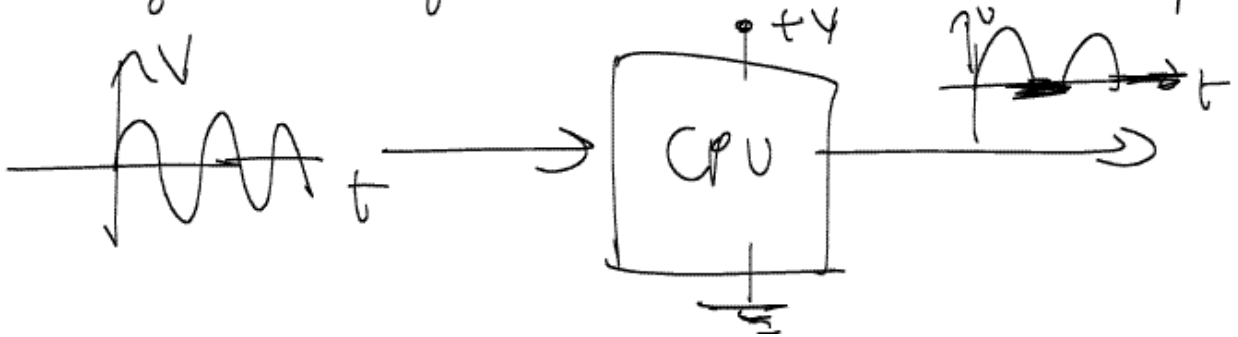
If $V_1 = 20\,V$, $V_2 \stackrel{?}{=} -\left(\frac{1k}{1k}\right)(20) + 2$ (From eqn. ②)

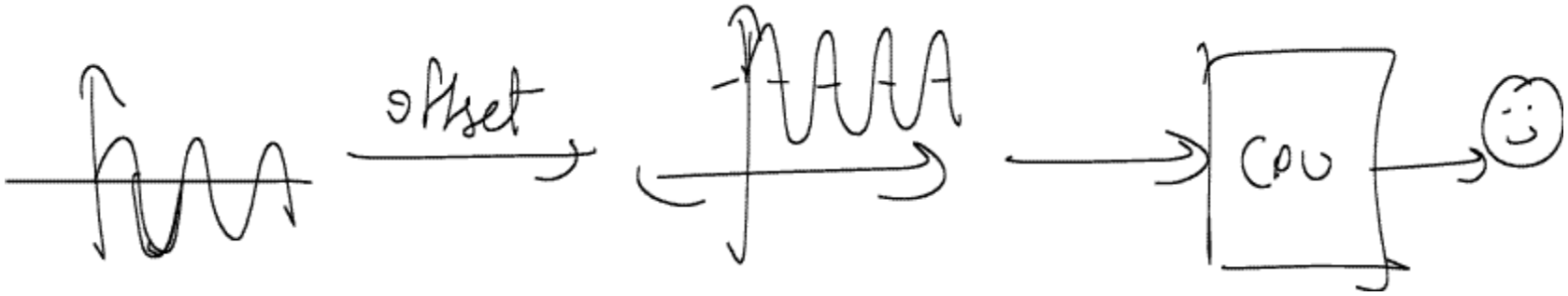
$V_2 \stackrel{?}{=} -18\,V$ Incorrect

because $V_o \neq -\left(\frac{1k}{1k}\right)20 = -20\,V$ → op-amp ① rails!!!!

$\therefore V_o = -10\,V$. $\therefore \boxed{V_2 = -8\,V}$

① Why do you need an offset "amplifier"?




offset
CPU