1ª PARCIAL

SIEK 13/14 Q2

Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú
UNIVERSITAT POLITÈCNICA DE CATALUNYA

Full núm. | Nombre total de fulls | Qualificació: 7'5

TEst. 7'5+1'5 = 9'0

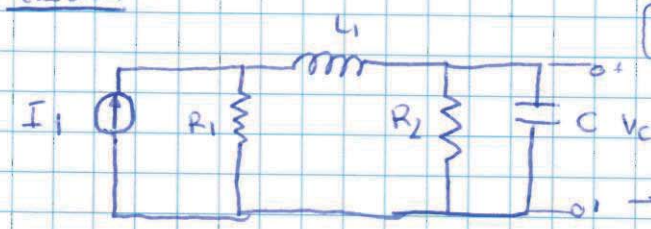
1r. Cognom | 2n. Cognom | Nom | D.N.I.

Especialitat: ELECTRICA | Curs: 13/14 Grup: N45

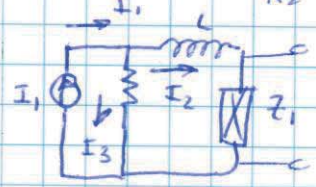
Assignatura: SIEK | Data: 11 / 4 / 14

P1) 3p

Exercici 1

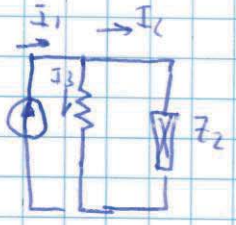


$Z_1 = \frac{1}{\frac{1}{R_2} + Cs} = \frac{\frac{1}{1}}{\frac{1+R_2Cs}{R_2}} = \frac{R_2}{1+R_2Cs}$



a) $H(s) = \frac{V_c(s)}{I_1(s)}$

- $I_1 = I_3 + I_2 \rightarrow I_3 = I_1 - I_2$
- $Z_2 = Ls + Z_1 = Ls + \frac{R_2}{1+R_2Cs} = \frac{Ls + R_2LCs^2 + R_2}{1+R_2Cs}$



- $V_{Z_2} = V_{R_1}$

$Z_2 \cdot I_2 = R_1 \cdot (I_1 - I_2) \rightarrow Z_2 I_2 = R_1 I_1 - R_1 I_2 \rightarrow I_2 = \left(\frac{R_1 I_1}{(Z_2 + R_1)}\right)$

$(R_1 + Z_2) I_2 = R_1 I_1$

$V_c(s) = V_{Z_1(s)} = Z_1 \cdot I_2 \Rightarrow$

$I_2 = \frac{R_1 I_1}{\left(\frac{Ls + R_2LCs^2 + R_2}{1+R_2Cs} + R_1\right)}$

$I_2 = \frac{R_1 I_1}{\frac{R_2LCs^2 + Ls + R_2 + R_1 + R_1R_2Cs}{1+R_2Cs}}$

$\frac{I_2}{I_1} = \frac{R_1 \cdot I_1 \cdot (1+R_2Cs)}{R_2LCs^2 + (L + R_1R_2C)s + (R_2 + R_1)}$

$V_c(s) = \frac{R_2}{1+R_2Cs} \cdot \frac{R_1 \cdot I_1 \cdot (1+R_2Cs)}{(R_2LCs^2 + (L+R_1R_2C)s + (R_2+R_1))}$

$H(s) = \frac{V_c(s)}{I_1(s)} = \frac{R_2R_1}{R_2LC\left(s^2 + \frac{(L+R_1R_2C)}{R_2LC}s + \frac{(R_1+R_2)}{R_2LC}\right)}$

$H(s) = \frac{R_1 \cdot /LC}{s^2 + \frac{(L+R_1R_2C)}{R_2LC}s + \frac{(R_1+R_2)}{R_2LC}}$ → continuació apartat a)

Fabricat ecològicament

$$H(s) = \frac{R_1/LC}{s^2 + \frac{(L + R_1R_2C)}{R_2LC}s + \frac{(R_1+R_2)}{R_2LC}}$$

$$\omega_n = \sqrt{\frac{(R_1+R_2)}{R_2LC}} \text{ rad/s}$$ 3p

a) H(s) B

K B

ξ B

$R_1 = 5\Omega$

ω_n B

$$K = \frac{R_1/LC}{\frac{(R_1+R_2)}{R_2LC}} = \frac{R_1R_2LC}{LC(R_1+R_2)} = \frac{R_1R_2}{(R_1+R_2)}$$

$$2\xi\omega_n = \frac{L + R_1R_2C}{R_2LC} \rightarrow \xi = \frac{L + R_1R_2C}{2 \cdot \sqrt{\frac{(R_1+R_2)}{R_2LC}} \cdot R_2LC}$$

$\omega_n = 2,24$

b) $V_C(s) = H(s) \cdot I(s)$

on $i(t) = 10\,u(t) \rightarrow \mathcal{L} \rightarrow \frac{10}{s}$ $\quad H(s) = \frac{V_C(s)}{I(s)} = \frac{1}{2,5} \cdot \frac{5}{s^2+2s+5}$

$$H(s) = \frac{2}{s^2+2s+5} \quad \xi \quad \omega_n = \sqrt{5} = 2,24 \text{ rad/s} \quad K = 0,4$$

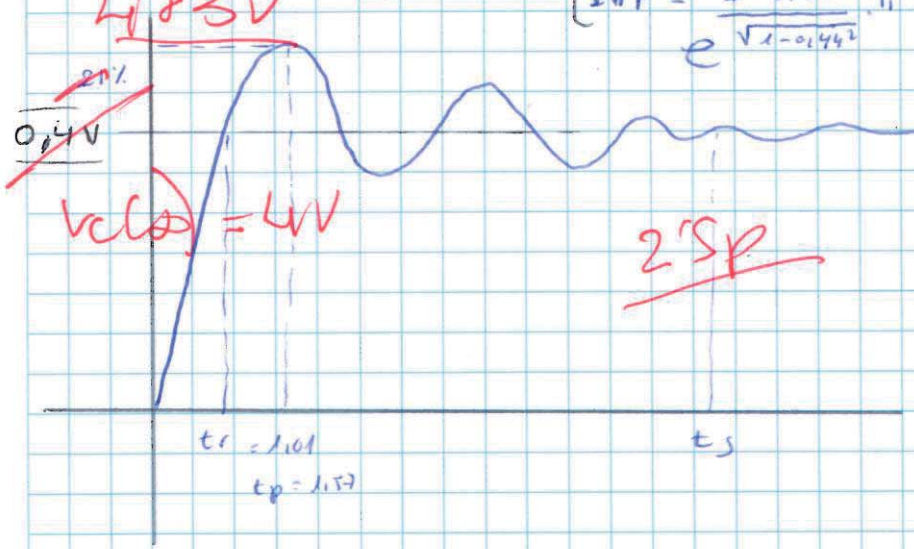
$$2\xi\sqrt{5} \cdot \xi = \frac{1}{\sqrt{5}} = 0,44$$

$$V_C(s) = \frac{2}{(s^2+2s+5)} \cdot \frac{10}{s} = \ldots$$

$s^2+2s+5 \rightarrow -1+2j$; $-1-2j$

$$\omega_d = \omega_n\sqrt{1-\xi^2} = \sqrt{5} \cdot \sqrt{1-0,44^2} = 2 \text{ rad/s}$$

$$\text{Ov\%} = e^{\frac{-0,44}{\sqrt{1-0,44^2}}\pi} = 0,21 \rightarrow 21\%$$



$$\beta = \tan^{-1}\left(\frac{2}{0,44 \cdot \sqrt{5}}\right) = 1,12 \text{ rad}$$

$$t_r = \frac{\pi - 1,12}{2} = 1,01\,s$$

$$t_p = \frac{\pi}{\omega_d} = \frac{\pi}{2} = 1,57\,s$$

5% $\rightarrow$ $t_s = \frac{3}{\xi\omega_n} = \frac{3}{0,44 \cdot \sqrt{5}} = 3,05\,s$

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c) $H(s) = \dfrac{2}{s^2+2s+5}$

$i_1(t) = 10\sin(2\pi t)$ $\quad f = 1\,Hz \rightarrow T = 1$

$V_c(t) = V_{ip} \cdot |H(j\omega)| \sin(\omega t + \angle H(j\omega))$

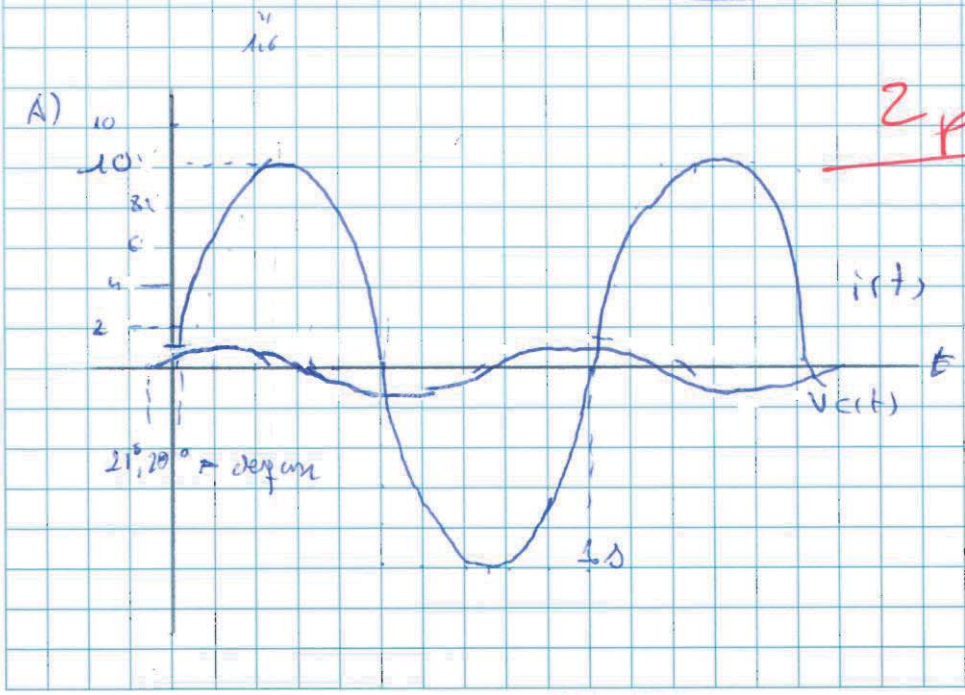
$|H(j\omega)| = \dfrac{0,4 \cdot 5}{\sqrt{(5-(2\pi)^2)^2 + (2 \cdot 0,44 \cdot \sqrt{5} \cdot 2\pi)^2}} = 0,054$ ✓

$\angle H(j\omega) = -\tan^{-1}\left(\dfrac{2 \cdot 0,44 \cdot \sqrt{5} \cdot 2\pi}{5-(2\pi)^2}\right) = 0,37\,rad \rightarrow 0,37\,rad \cdot \dfrac{180^\circ}{\pi\,rad} = 21,20^\circ$

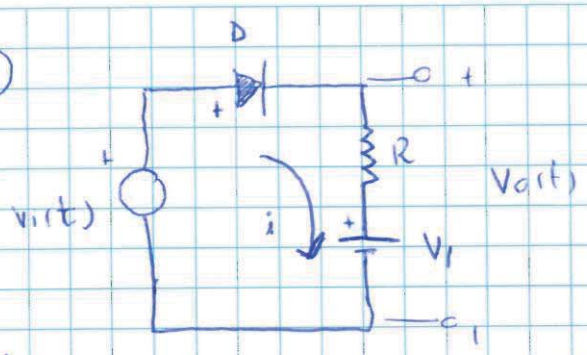
$-2,77\,rad$

$V_c(t) = 10 \cdot 0,054 \sin(2\pi t + 21,20^\circ)$

A) 2p



(2)



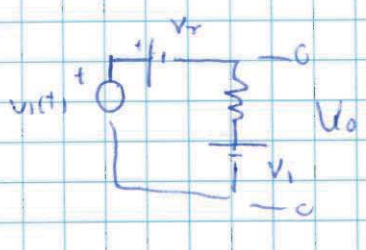
a)

D_1 ON $\rightarrow$ $-V_i(t) + V_d + V_o = 0 \rightarrow V_o = V_i(t) - V_d$

id > 0 $V_d = V_\gamma$

$V_o = Ri + V_1 \rightarrow i = \frac{V_o - V_1}{R} > 0 \rightarrow \frac{V_i(t) - V_d - V_1}{R} > 0$

$\boxed{V_i(t) > V_1 + V_\gamma}$ condició D_1 ON



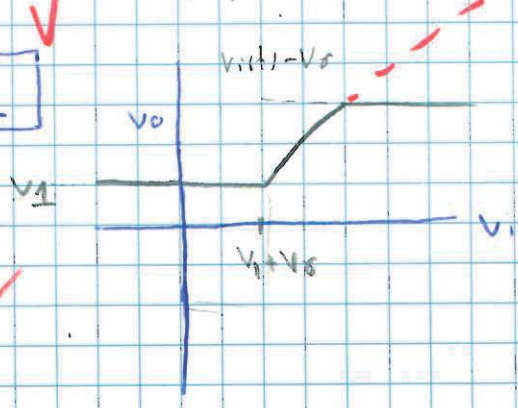
$\boxed{V_o = V_i(t) - V_\gamma}$ $\rightarrow$ SORTIDA

D_2 OFF

$V_d < V_\gamma \rightarrow i_d = 0$

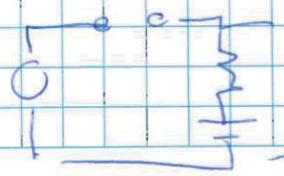
$V_o = Ri + V_1 \rightarrow \boxed{V_o = V_1}$

Gràfica xy.



D_2 ON

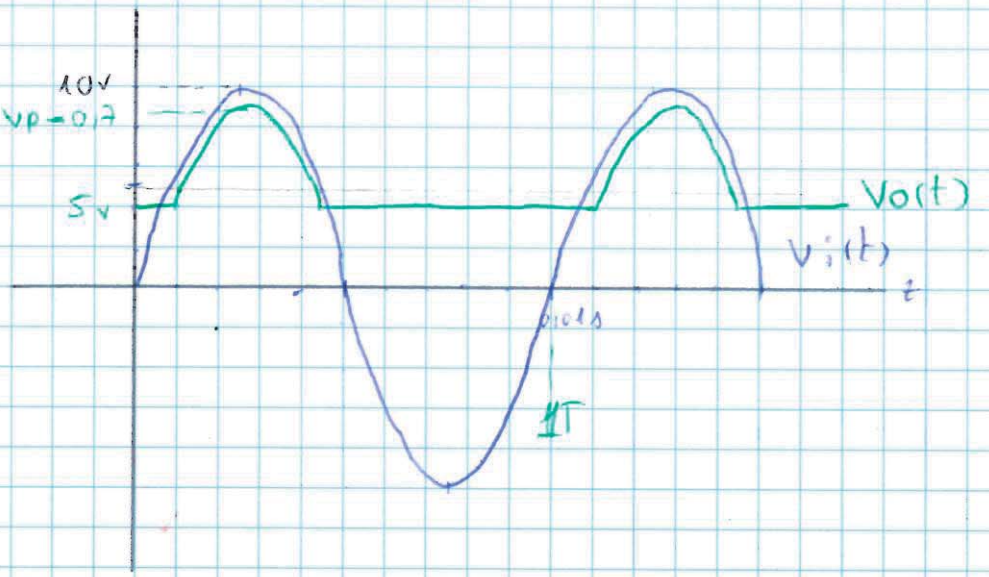
$\boxed{V_i(t) < V_1 + V_\gamma}$



b) $R = 2000\,\Omega$

$V_1 = 5\,V$

$V_i(t) = 10\sin(200\pi t)$



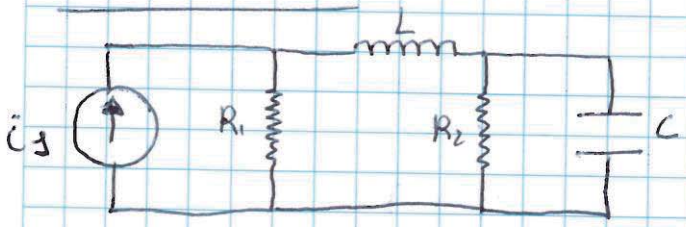
$V_i(t) > V_d + V_R \rightarrow V_i(t) > 5,07\,V$

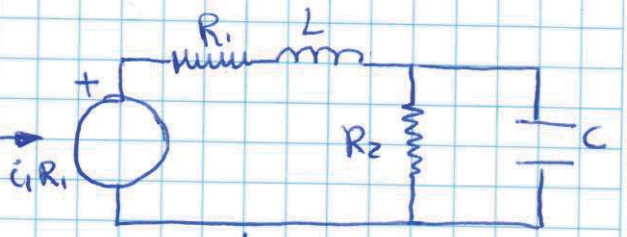
$V_i(t) < 5,07\,V$

Total: 7'25+0 (=7'25)

P1) a) 3p

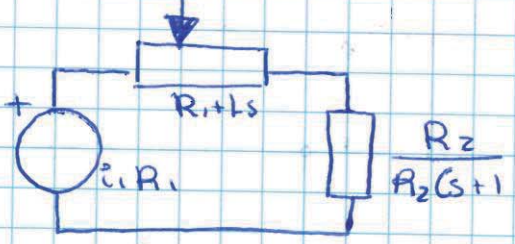
Problema 1





a)

$$V_C = \frac{\frac{R_2}{R_2(Cs+1)}}{R_1 + Ls + \frac{R_2}{R_2(Cs+1)}} \cdot V_i$$



3p

$$V_C = \frac{R_2}{R_1 R_2 Cs + R_1 + R_2 CLs^2 + Ls + R_2} \cdot V_1 =$$

a) H(s) B

K B

ξ B

ω_n B

$$= \frac{R_2}{R_2 CLs^2 + (R_1 R_2 C + L)s + R_1 + R_2} \cdot V_1$$

$$H = \frac{V_C}{i_1} = \frac{R_1 \cdot R_2}{R_2 CLs^2 + (R_1 R_2 C + L)s + R_1 + R_2} = \frac{\frac{R_1}{CL}}{s^2 + \left(\frac{R_1 R_2 C + L}{R_2 CL}\right)s + \frac{R_1 + R_2}{R_2 CL}}$$

$$\frac{K \cdot \omega_n^2}{s^2 + 2\xi\omega_n + \omega_n^2}$$

$$\rightarrow \omega_n^2 = \frac{R_1 + R_2}{R_2 CL} \rightarrow \omega_n = \sqrt{\frac{R_1 + R_2}{R_2 CL}}$$

$$\rightarrow K = \frac{\frac{R_1}{CL}}{\frac{R_1 + R_2}{R_2 CL}} = \frac{R_1 \cdot R_2}{R_1 + R_2}$$

$$\rightarrow \xi \rightarrow 2\xi\omega_n = \frac{R_1 R_2 C + L}{R_2 CL} \rightarrow \xi = \frac{R_1 R_2 C + L}{2R_2 CL \cdot \sqrt{\frac{R_1 + R_2}{R_2 CL}}}$$

b) $H(s) = \frac{1}{2'5} \cdot \frac{5}{s^2 + 2s + 5}$

$\omega_n^2 = 5 \rightarrow \omega_n = \sqrt{5}$

$K = \frac{1}{2'5}$

$2\zeta\omega_n = 2 \rightarrow \zeta = \frac{1}{\omega_n} = \frac{1}{\sqrt{5}}$

$Sip = e^{\frac{-\pi \cdot \zeta}{\sqrt{1-\zeta^2}}} = 0'2079$ ✓

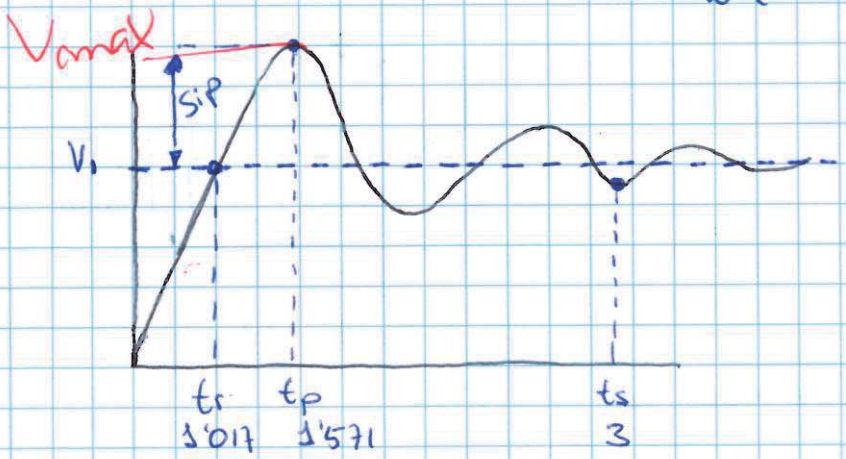
$\omega_d = \omega_n \sqrt{1-\zeta^2} = 2$ rad ✓

$t_s = \frac{3}{\zeta\omega_n} = 3$ sec ✓

$t_p = \frac{\pi}{\omega_d} = 1'571$ ✓

$B = \tan^{-1}\left(\frac{\omega_d}{\zeta\omega_n}\right) = 1'107$

$t_r = \frac{\pi - B}{\omega_d} = 1'017$ ✓



$V_C(\infty)$??

2'Sp

c) $|H(j\omega)| = \frac{1}{2'5} \cdot \frac{5}{\sqrt{(5-(2n)^2)^2 + (2\cdot 2n)^2}} = 0'18$

$T = 2n\,W = 39'47$

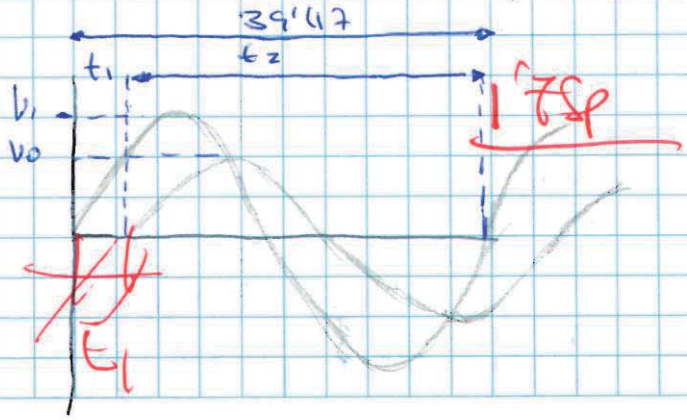
$\Delta H(j\omega) = -\tan^{-1}\left(\frac{2\cdot 2n}{5-(2n)^2}\right) = \mp 0'34$ ✓

$H(j\omega) = \frac{V_o}{V_i}$

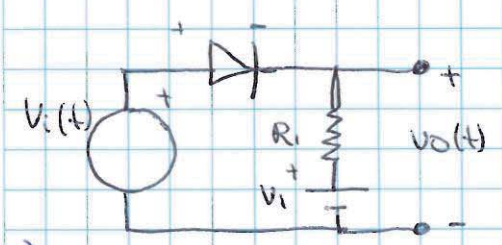
↳ señal avanzada

$\Delta H(j\omega) = \begin{cases} -\frac{t_1}{T} 2n & t_1 < t_2 \\ \frac{t_2}{T} 2n & t_1 > t_2 \end{cases}$

t_1? t_2?



Problema 2.



$i_D = i_R$

$V_i(t) = \frac{V_D + V_R - V_i}{R} = \frac{V_D - V_i + i_r \cdot R}{R}$

$\frac{V_i}{R} = V$?

a)

① ON

$i_D > 0 \quad V_D = V_\varphi$ ✓ $+V_1$

$V_i(t) = \frac{V_D - V_i + i_D R}{R} \Rightarrow R V_i(t) = V_D - V_i + i_D R \rightarrow \frac{R V_i(t) - V_D + V_i - i_r}{R}$

$i_D > 0 \rightarrow R V_i(t) - V_\varphi + V_1 > 0$

$\boxed{R V_i(t) + V_1 > V_\varphi}$ μ.

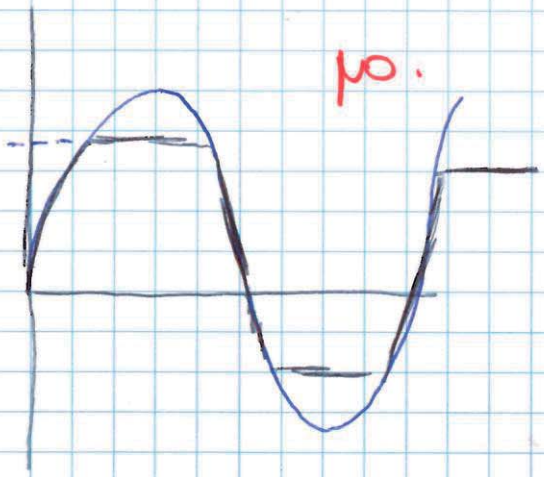
② OFF

$V_d < V_\varphi \quad i_D = 0$ ✓

$V_i(t) \cdot R = V_D - V_1 \rightarrow V_D = V_i(t) R + V_1$ μ.

$V_D < V_\varphi \rightarrow \boxed{V_i(t) R + V_1 < V_\varphi}$

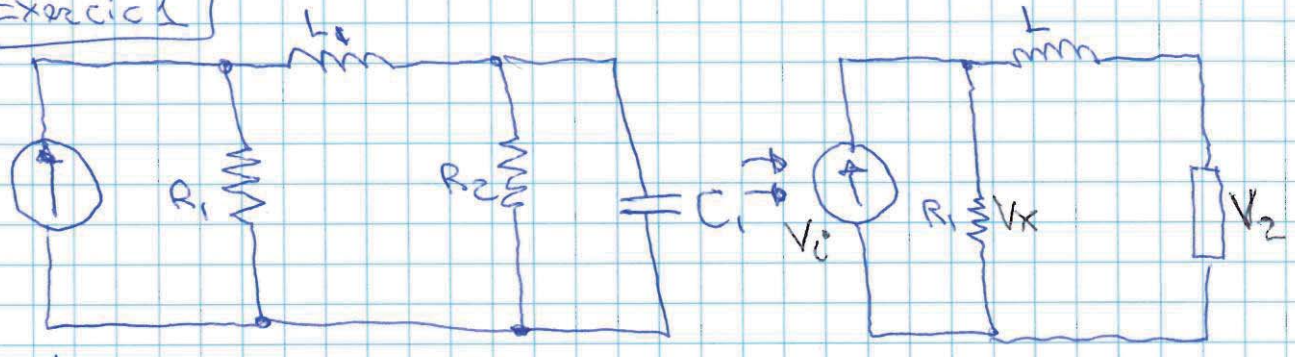
b) $v_i(t) = 10 \sin(2\pi 100\, t)$



Total: 5'7+0'3 = 6'0

P1) a) 2'7p

Exercici 1



$$Z_{TH} = \frac{R_2 \cdot \frac{1}{C_1 s}}{R_2 + \frac{1}{C_1 s}} = \frac{\frac{R_2}{C_1 s}}{\frac{R_2 C_1 s + 1}{C_1 s}} = \frac{R_2}{R_2 C_1 s + 1}$$

$$V_2 = \frac{\frac{R_2}{R_2 C_1 s + 1}}{\frac{R_2}{R_2 C_1 s + 1} + L s} V_x = \frac{\frac{R_2}{R_2 C_1 s + 1}}{\frac{R_2 + R_2 L C_1 s^2 + L s}{R_2 C_1 s + 1}} = \frac{R_2}{R_2 L C_1 s^2 + L s + R_2} V_x$$

$$V_x = \frac{R_1 \left(L s + \frac{R_2}{R_2 C_1 s + 1} \right)}{R_1 + L s + \frac{R_2}{R_2 C_1 s + 1}} = \frac{\frac{R_1 L s R_2 C_1 s^2 + R_1 L s + R_2 R_1}{R_2 C_1 s + 1}}{\frac{R_1 R_2 C_1 s + R_1 + R_2 C_1 s^2 + L s + R_2}{R_2 C_1 s + 1}} =$$

$$= \frac{R_1 R_2 L C_1 s^2 + R_1 L s + R_1 R_2}{R_2 C_1 L s^2 + R_1 R_2 C_1 s + L s + R_1 + R_2} V_i$$

$$\frac{V_2}{V_i} = \frac{R_2}{R_2LCs^2+Ls+R_2} \cdot \frac{R_2LCs^2+Ls+R_2/R_1}{R_2LCs^2+R_1R_2Cs+Ls+R_1+R_2} =$$

error algebraico!!!

$$= \frac{R_1R_2}{R_2LCs^2+(R_1R_2+L)s+R_1+R_2} = \frac{R_1R_2LC}{s^2+\left(\frac{R_1R_2+L}{R_2LC}\right)s+\left(\frac{R_1+R_2}{R_2LC}\right)} =$$

$$= \frac{R_1}{LC} \cdot \frac{1}{s^2+\left(\frac{R_1R_2+L}{R_2LC}\right)s+\left(\frac{R_1+R_2}{R_2LC}\right)} =$$

$$\circledast \quad \frac{R_1R_2LC}{LC(R_1+R_2)}$$

$$= \frac{\left(\frac{R_1R_2LC}{LC(R_1+R_2)}\right)\cdot\left(\frac{R_1+R_2}{R_2LC}\right)}{s^2+\left(\frac{R_1R_2+L}{R_2LC}\right)s+\left(\frac{R_1+R_2}{R_2LC}\right)}$$

$$K = \frac{R_1R_2LC}{LC(R_1+R_2)}$$

$$\omega_n = \sqrt{\frac{R_1+R_2}{R_2LC}}$$

$$\zeta = \frac{\left(\frac{R_1R_2+L}{R_2LC}\right)}{2\cdot\sqrt{\frac{R_1+R_2}{R_2LC}}}$$

2'7p

a) $H(s)$ B + 2p

K B 0'25p

ζ B+ 0'2p

ω_n B 0'25p

1r. Cognom | 2n. Cognom | Nom | D.N.I.

Especialitat: | Curs: | Grup: V4512

Assignatura: SIEK | Data: / /

Exercici 1

b) $i(t) = 4u(t)$ → $H(s) = \frac{V_c(s)}{I_1(s)} = \frac{1}{2'5} \cdot \frac{5's}{s^2+2s+5}$ 1'0 ✓

$H(s) = \left(\frac{4}{s}\right) \cdot \frac{5s}{s^2+2s+5}$ $\omega_n = \sqrt{5}$ rad/s

$2\xi\omega_n = 2$, $\xi = \frac{2}{2\cdot\sqrt{5}} = 0'447$ ✓

$\omega_d = \sqrt{5}\cdot\sqrt{1-0'447^2} = 2$ rad/s $t_p = \frac{\pi}{2} = 1'57$ s ✓

$t_s = \frac{3}{0'447\cdot\sqrt{5}} = 3$ s ✓ $\beta = \tan^{-1}\left(\frac{2}{0'447\cdot\sqrt{5}}\right) = 63'46°$

$SiP = e^{-1'57} = 0'2 \rightarrow 20'8\%$ $t_r = \frac{\pi - 63'46}{2} = 1'02$ s 1'0

$V_c = \frac{\omega_n t}{\sqrt{1-\xi^2}} \cdot e^{-\xi\omega_n t} \cdot \sin\left(\omega_n t\cdot\sqrt{1-\xi^2}\right)$ $V_c(\infty) = ?$ 1'5p

$V_c = 2'5t \cdot e^{-t} \cdot \sin(1'8t)$

forma d'ona ?

c) $i_1(t) = 10 \cdot \sin(2\pi t)$ $\quad \omega = 2\pi$

$$H(s) = \frac{2}{s^2+2s+5} = \frac{2}{-39'48+12'56j+5} =$$

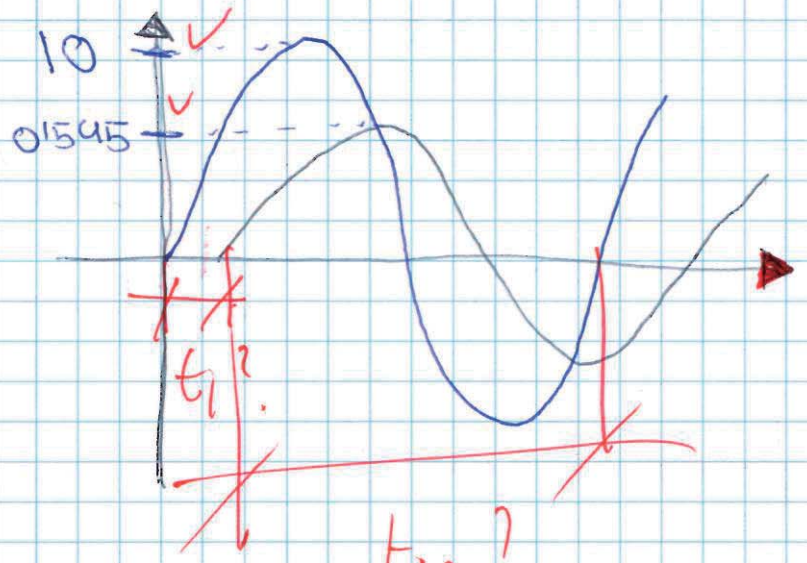
$$= \frac{2}{12'56j-34'48}$$

$$\cdot \text{Modul} = \frac{\sqrt{0^2+2^2}}{\sqrt{(12'56)^2+(-34'48)^2}} = \frac{2}{36'7} = 0'0545$$ ✓

$$\cdot \text{Fase} = -\operatorname{arctg}\frac{0}{2} - \operatorname{arctg}\frac{12'56}{-34'48} =$$

$= -20°$ | $-2'79\,\text{rad} \rightarrow -160°$

$$i_1(t) = 0'545 \cdot \sin(2\pi t - 20°)$$



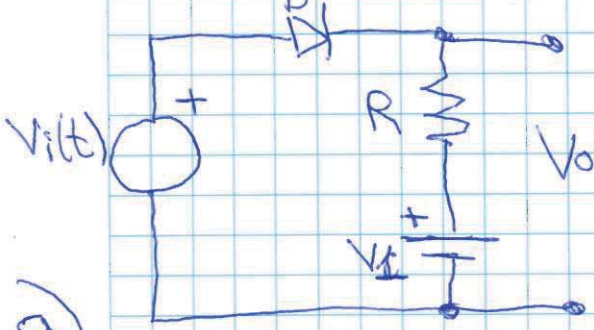
$1'7\,s_p$

1r. Cognom | 2n. Cognom | Nom | D.N.I.

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Assignatura: SIEK | Data: / /

Exercici 2 $V_\gamma = 0'7$



a)

$D = ON$ [$i_d > 0$ $V_d = V_\gamma$]

$i_R = \frac{-V_{d_1} + V_1 - V_i}{R} > 0$;

$-V_i > V_{d_1} + V_1$; $V_i < -V_d - V_1$ 0,15

$D = OFF$ [$i_d = 0$ $V_D < V_\gamma$]

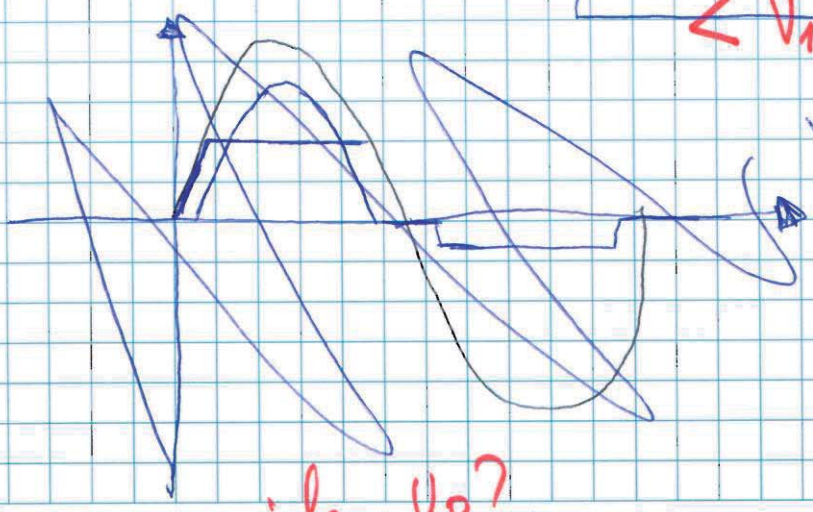
$V_i < V_{d_1} + V_1$

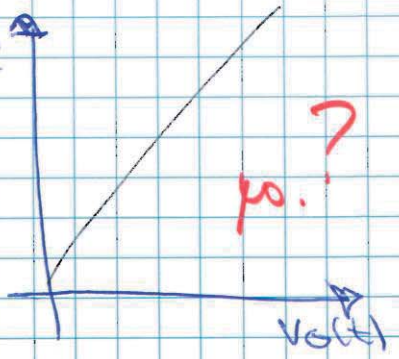
$> V_2$

$V_i + V_{d_1} + V_1 = 0$; $V_{d_1} = -V_i - V_1$;

$V_2 > -V_i - V_1$; $+V_i > V_2 - V_1$ 0,15

$< V_1 + V_\gamma$





μ. ?

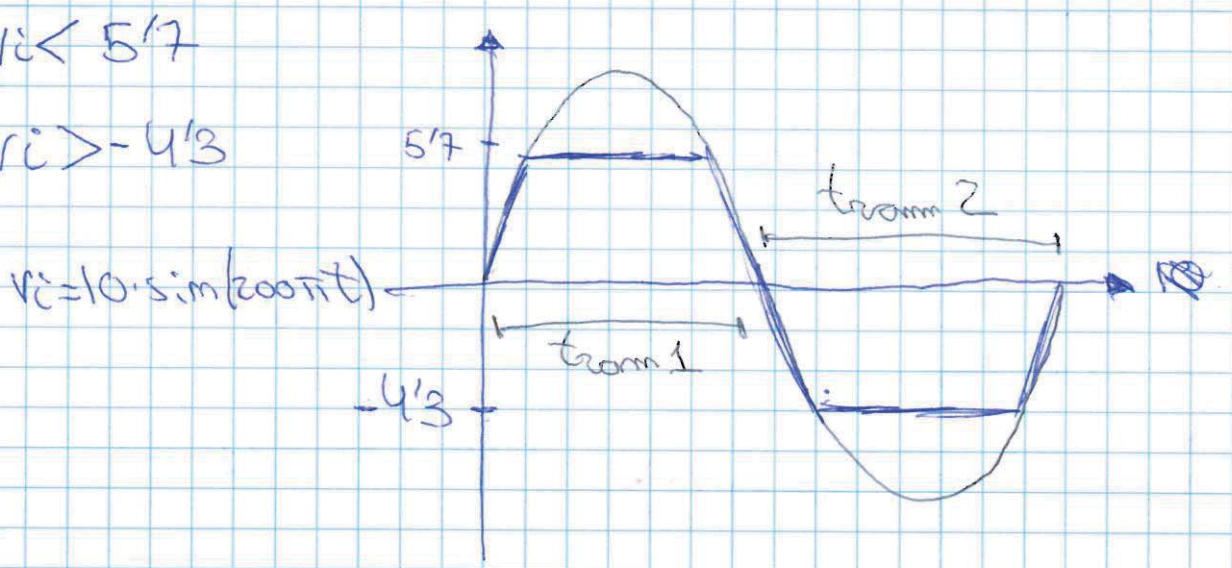
i les V_o?

Imprès en paper reciclat ecològicament

D) · R=2KΩ · V_1=5V · $v_i(t)$ 10·sin(2π·100t)

· v_i < 5'7

· v_i > -4'3



Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú
UNIVERSITAT POLITÈCNICA DE CATALUNYA

Full núm. | Nombre total de fulls | Qualificació 2.75

1r. Cognom | 2n. Cognom | Nom | D.N.I.

Especialitat: | Curs: | Grup:

Assignatura: | Data:

Total: 2'75 + 0'1 = 2'85

P1) a) 0'25p

El eq. Thevenin es ERRONEO! GRAVE ERROR DE teoría de circuitos!

Esta tensión NO es una fuente independiente de tensión ERROR DE teoría de circuitos!!

$$V_c(s) = \frac{1/C_1 s}{1/C_1 s} \cdot V_{R_2}(s) = \frac{V_i}{R_1}$$

$$i_a = i_1(s)$$

$$\begin{bmatrix} \frac{V_i}{R_1+L_1} \\ V_c(s) \end{bmatrix} = \begin{bmatrix} R_1+L_1 s+R_2 & -R_2 \\ -R_2 & R_2+\frac{1}{C_1 s} \end{bmatrix} \begin{bmatrix} i_a \\ i_b \end{bmatrix}$$

$$i_a = \frac{\begin{vmatrix} \frac{V_i}{R_1+L_1} & -R_2 \\ V_c(s) & R_2+\frac{1}{C_1 s} \end{vmatrix}}{\begin{vmatrix} R_1+L_1 s+R_2 & -R_2 \\ -R_2 & R_2+\frac{1}{C_1 s} \end{vmatrix}} = \frac{\frac{V_i}{R_1+L_1 s}\left(R_2+\frac{1}{C_1 s}\right)+R_2 \cdot V_c(s)}{(R_1+L_1 s+R_2)\left(R_2+\frac{1}{C_1 s}\right)-R_2 \cdot R_2}$$

No se puede da H(s) NO contener una tensión!!!!!!

Falta acabar

$$H(s) = \frac{V_c(s)}{i_1(s)} = \frac{V_i/R_1+L_1(s)}{\frac{V_i}{R_1+L_1 s}\left(R_2+\frac{1}{C_1 s}\right)+R_2 \cdot V_i/R_1} = \frac{V_i/R_1+L_1(s)}{\frac{V_i}{L_1 s+R_1} \cdot R_2 + \frac{V_i}{R_1} \cdot \frac{1}{C_1 s} + R_2 \cdot \frac{V_i}{R_1}}$$

$$= \frac{V_i/R_1+L_1(s)}{\frac{V_i}{R_1+L_1 s}\left(R_2+\frac{1}{C_1 s}+R_2\right)} = \frac{1/R_2+1/C_1 s+R_2}{R_1\left(R_2+\frac{1}{C_1 s}\right)+L_1 s\left[\frac{1}{C_1 s}+R_2\right]+\left(R_2 \frac{1}{C_1 s}\right)}$$

a) H(s) M 0'25p

$$K \cdot \frac{\omega_n^2}{s^2+2\xi\omega_n s+\omega_n^2} \qquad \omega_n = \sqrt{\frac{1}{R_2}+\frac{1}{C_1 s}+R_2}$$

K ? 0p

ξ ? 0p

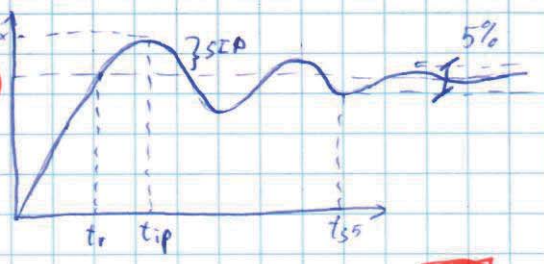
ω_n ? 0p

b)

$$H(s) = \frac{V_c(s)}{i_1(s)} = \frac{1}{7.5} \cdot \frac{5}{s^2 + 2s + 5}$$

$K \cdot I_1$? (9)

$$w_d = w_n \sqrt{1 - \xi^2} = \sqrt{5} \cdot \sqrt{1 - \left(\frac{1}{\sqrt{5}}\right)^2} = 2 \text{ rad/seg}$$ ✓



$w_n = \sqrt{5}$

$\xi = \frac{1}{\sqrt{5}}$

$$SIP = e^{-\xi \frac{w_n}{w_d} \cdot \pi} = 0{,}207$$ ✓

$20{,}7\% \rightarrow V_{max} = V_i + SIP$

$2.2 S_p$

$$t_r = \frac{1}{w_d} \tan^{-1}\left(\frac{w_d}{\sigma}\right) \quad \text{on} \quad \sigma = -\xi w_n \rightarrow t_r = 0{,}553 \text{ seg}$$

$$t_p = \frac{\pi}{w_d} = \frac{\pi}{2} s. \qquad t_{5s} = \frac{3}{\xi \cdot w_n} = 3 \text{ sec.}$$

$V_c(\infty)$, $V_c(max)$

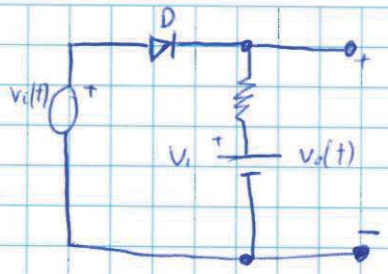
falta apartat c?

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2.



$D_1 = ON$ $\quad v_{D_1} = V_\gamma$ $\quad i_{D_1} > 0$

$i_{D_1} = i_R = \dfrac{v_{in}(t) - v_o(t)}{R}$?

$\dfrac{v_{in}(t) - V_\gamma}{R} > 0 \quad \boxed{v_{in}(t) > V_\gamma}$ NO.

$D = OFF$

$v_D < V_\gamma$
$i_D = 0$

$v_D = v_i(t) < V_\gamma \rightarrow \boxed{v_{in}(t) < V_\gamma}$ NO.

$$V_o \begin{cases} V_\gamma & \text{if } v_{in}(t) > V_\gamma \\ -V_\gamma & \text{if } v_{in}(t) < V_\gamma \end{cases}$$

