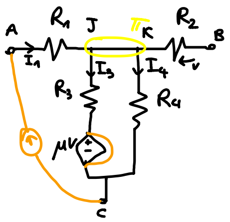


uso le prove semplici

$$T_R : \begin{cases} V_1 = R_{11} I_1 + R_{12} I_2 \\ V_2 = R_{21} I_1 + R_{22} I_2 \end{cases}$$

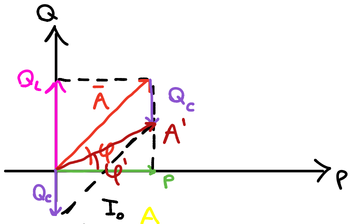
– cerco $R_{11} = \frac{V_1}{I_1}$ e $R_{21} = \frac{V_2}{I_1}$ se $I_2 = 0$ $\qquad V=0 \rightarrow \mu V = 0$

$\rightarrow$ KVL A-C-J-A) $I_1 R_1 + V_1 + I_3 R_3 = 0 \rightarrow V_1 = -(I_1 R_1 + I_1 R_3 - I_4 R_3)$

so che $I_1 = I_3 + I_4$ e $I_4 =$

ES. RIFASAMENTO

$\cos\varphi = 0{,}8 \rightarrow Q = 7500$ VA R $\rightarrow P_{APP} = |\bar{A}| = \sqrt{P^2 + Q^2} = 12500 = \frac{P}{\cos\varphi}$ VA A $\rightarrow$ apparenti

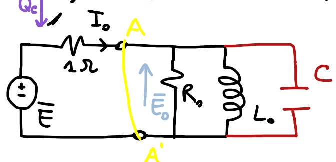


so che $|\bar{A}| = I_o^{eff} V_o^{eff} \rightarrow I_o^{eff} = \frac{|\bar{A}|}{V_o^{eff}} = \frac{12500}{200} = 62{,}5\ A_{eff}$

$\rightarrow P_R = 1\,\Omega (I_o^{eff})^2 = 3966$ W

per passare da $\cos\varphi = 0{,}8 \rightarrow \cos\varphi = 0{,}9$ aggiungo $Q_c\ (<0)$

$\rightarrow Q_c = \underbrace{7500}_{Q_A} - \overbrace{4843{,}8}^{Q_{A'}} = 2656{,}8$ capacitivi



cerco $|\bar{E}|$ ($200\ V_{eff}$)

TH. BOUCHEROT $\bar{A}_{BB'} = \bar{A}_{AA'} + P_R = 10$ kW $+ 7500i + 3966$ W $= 13966 + i7500$ VA R

$\rightarrow |\bar{A}_{BB'}| = I_{eff} |\bar{E}|_{eff} \rightarrow |\bar{A}_{BB'}| = \sqrt{13966^2 + 7500^2} = 15852$ VA A

$\rightarrow 15852 = 62{,}5 \cdot \frac{|\bar{E}_{eff}|}{200} \rightarrow \frac{15852 \cdot 200}{62{,}5} = |\bar{E}_{eff}| = 253{,}63$ prima rif.

reg. partitore: $\bar{E}_o = E \frac{Z_{eq}}{Z_{eq} + R}$ senza condensatore

$P_R = \frac{1}{2} \frac{|\bar{V}_{R_o}|^2}{R_o} = \frac{|\bar{V}_{R_o}^{eff}|^2}{R_o} \rightarrow R_o = \frac{200^2}{10K} = 4\,\Omega$

$Q_{L_o} = \frac{|V_o^{eff}|^2}{\omega L} \rightarrow L = 17$ mH $\qquad C_o = 211{,}4\ \mu F$

Z_{eq} : $L // C = 211{,}4 \cdot 10^{-6} \cdot \underbrace{100\pi}_{\omega} - \frac{1}{1{,}7 \cdot 10^{-3} \cdot \underbrace{100\pi}_{\omega}} = -0{,}12083\ [S]$ di tipo induttivo (parte imm.)

$Z_{eq} = \frac{4 \cdot \frac{-1}{0{,}12083 i}}{4 - \frac{1}{0{,}12083 i}} = 3{,}2425 + \underbrace{1{,}56 i}_{\text{ind.}} \rightarrow R_o // L // C$

$\rightarrow \bar{E}_o' = \bar{E} \frac{Z_{eq}}{Z_{eq} + R_o} = \frac{3{,}2425 + 1{,}56i}{(1 + 3{,}2425) + 1{,}56i} |253{,}63| = 201{,}96\ V_{eff}$ $\hookrightarrow$ prima rif

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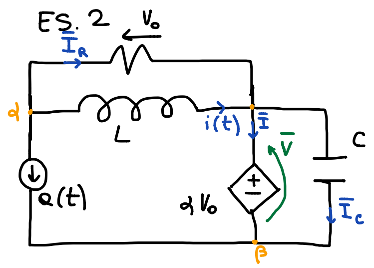
APPELLO 9-07-18

ES. 1

ES. 2



$a(t) = 3\,\text{sen}(10t-\pi)$; $R = 2\,\Omega$; $L = 0{,}1\,H$; $C = 1\,F$; $\alpha = 2$

so che: $\bar I_L + \underbrace{i\omega L \bar I_L \frac{1}{R}}_{\bar I_R} + \bar a = \varnothing$ → KCL α I

→ $\bar A = \frac{1}{2}\bar V \bar I^*$ con $\bar V = \alpha \bar V_0 = i\alpha\omega L \bar I_L$

KCL β) $\bar I + \bar a + \underbrace{\alpha V_0 i\omega C}_{\bar I_C} = 0$ II

$a(t) = 3\,\text{sen}(10t-\pi) = 3\cos(\underset{\omega}{10}t - \frac{3}{2}\pi)$

$\bar a = 3e^{-\frac{3}{2}\pi i} = 3i$

I → $\bar I_L + i\,10\cdot 0{,}1\,\bar I_L \frac{1}{2} + 3i = 0$ → $\bar I_L = -6\,\frac{i(2-i)}{4+1} = -\frac{6}{5}(1+2i)$

→ $I_L(t) = -\frac{6}{5}\,Re[\bar I_L] = -\frac{6}{5}(\cos(10t) - 2\,\text{sen}(10t))$

so che: $\bar V = i\alpha\omega L \bar I_L = -\frac{12}{5}(i-2)$

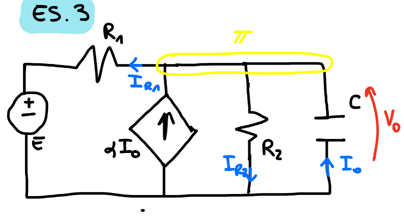
II → $\bar I = -(\bar a + \bar I_C) = -3i - i\cdot 10\cdot 1\cdot \frac{12}{5}(2-i) = -3i - 48i - 24 = -24 - 51i$

devo togliere L

→ complesso coniugato

$\bar A = \frac{1}{2}\bar V \bar I^* = \frac{1}{\cancel{2}}\cdot\frac{\cancel{12}^{\,6}}{5}(2-i)(-24-51i)^* = \frac{6}{5}(2-i)(-24+51i)$

ES. 3



$E = 3V$ $R_1 = 1k\Omega$ $R_2 = 2k\Omega$ $\alpha = 2$ $C = 1\,mF$

$V_0(t_0 = 0) = 1V$ $V_0(t)$ $t \geq t_0 = \varnothing$

$I_0(t)$ \\

KCL π) $\frac{V_0}{R_2} + \frac{V_0 - E}{R_1} - \alpha I_0 + \underbrace{C\dot V_0}_{-I_0} = 0$

→ $\frac{V_0}{R_2} + \frac{V_0 - E}{R_1} + 2C\dot V_0 + C\dot V_0 = 0$ → $\frac{V_0}{2k} + \frac{V_0}{1k} - \frac{3}{1k} + 2\cdot 10^{-3}\dot V_0 + 10^{-3}\dot V_0 = 0$

EQ. DI STATO → $\begin{cases} 2\dot V_0 + V_0 - 2 = 0 \\ V_0(0) = 1 \end{cases}$ → $V_0(t) = k e^{-\frac{t}{2}} + 2$ $\lambda = \frac{1}{CR} = \frac{1}{1\cdot 2}$ → $-\lambda = -\frac{1}{2}$

se $t \to +\infty$ → $V_0(t) = 2\,V$

cond. e partitore se ne vanno

cerco K: $V_0(t=0)=k+2=1 \rightarrow K=-1 \quad \rightarrow V_0(t)=-e^{\frac{t}{2}}+2$

def. $I_0(t)=-c\dot{V}_0=-10^{-3}\frac{1}{2}e^{-\frac{t}{2}}=-0{,}5e^{-\frac{t}{2}}mA$

Det esp. temporali relative a grandezze sinusoidali rapp dai seguenti fasori:

$\bar{V}=j8e^{-j20°} \rightarrow \bar{V}=8je^{j90°}\cdot e^{-j20°}=8je^{j70°} \rightarrow V(t)=8\cos(\omega t+\frac{7}{18}\pi)$

$\frac{\pi}{9}$; $\frac{\pi}{2}-\frac{\pi}{9}=\frac{7}{18}\pi$

$\bar{I}=-3+j4 \rightarrow I(t)=Re\{(-3+j4)(\cos(\omega t)+j\,sen(\omega t))\}=Re\{-3\cos(\omega t)-4\,sen(\omega t)+j(\dots)\}=$

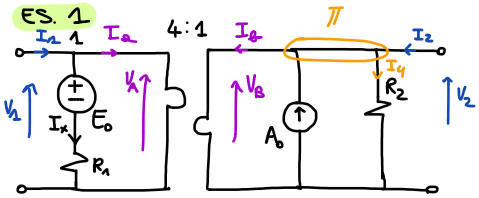
$=-3\cos(\omega t)-4\,sen(\omega t)$ $1°$ metodo

$\bar{I}=j(5-j12)=12+j5 \rightarrow |\bar{X}|=\sqrt{12^2+5^2}=\sqrt{169}=13 \rightarrow \bar{I}=13e^{j\,arctg(\frac{5}{12})}$

$\measuredangle\bar{X}=arctg\left(\frac{5}{12}\right)$

APPELLO 27-06-19

ES. 1



rappresentazione R

$\begin{cases} V_1=r_{11}I_1+r_{12}I_2+E_1 \\ V_2=r_{21}I_1+r_{22}I_2+E_2 \end{cases}$

$R_1=16\,\Omega$; $R_2=1\,\Omega$; $E_0=4\,V$; $A_0=5\,A$

so che: $\begin{cases} V_A=4V_B \\ I_A=-\frac{1}{4}I_B \end{cases}$

Procedo tram. metodo diretto

$\rightarrow$ noto x KVL esterne: $V_1=V_A \wedge V_2=V_B \rightarrow V_1=4V_2$

trovo V_1: KCL 1 $\rightarrow I_1-I_x-I_A=0 \rightarrow I_A=I_1-\frac{V_1-E_0}{R_1}$

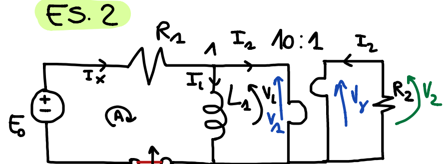
$I_B=I_2+A_0-\frac{V_2}{R_2}$

$\rightarrow I_A=-\frac{1}{4}I_B \rightarrow I_1-\frac{4V_2}{R_1}+\frac{E_0}{R_1}=-\frac{1}{4}I_2-\frac{1}{4}A_0+\frac{V_2}{4R_2} \rightarrow V_2\left(\frac{4}{R_1}+\frac{1}{4R_2}\right)=I_1+\frac{I_2}{4}+\frac{E_0}{R_1}+\frac{A_0}{4}$

$V_2\left(\frac{1}{2}\right)=I_1+\frac{I_2}{4}+\frac{3}{2} \rightarrow V_2=2I_1+\frac{1}{2}I_2+3$

$V_1=4V_2=8I_1+2I_2+12$

ES. 2

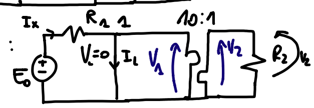


$t_0=0 \rightarrow S_0$ aperto. Det $V_2(t)$, $t(-\infty,+\infty)$

E_{R_2}?

$R_1=1\,\Omega$; $R_2=10\,\Omega$; $L_1=1$ mH; $E_0=10$ V

RETE x $t<0$:

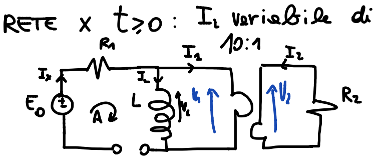


$L \rightarrow$ c.c.

$\rightarrow V_1=10V_2 \quad \wedge \quad I_1=-\frac{1}{10}I_2 \quad \rightarrow V_L=0=V_1=V_2$

KCL 1) $I_L=I_x=\frac{E_0}{R_1}$ a $t=0^-$

RETE x $t\geq 0$: I_L variabile di stato $\rightarrow I_L(0^+)=\frac{E_0}{R_1}$



$V_L=V_1=10V_2$

cerco rel. V_L e I_L $\rightarrow V_L=L\frac{dI_L}{dt}$

$I_1=I_L$

$V_L = -10V_2 = -10 I_L R_2 \rightarrow L\frac{dI_L}{dt} = -10 I_L R_2 \rightarrow \frac{dI_L}{dt} = -\frac{10R_2}{L} I_L$

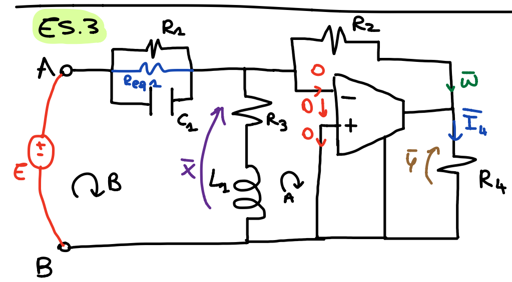
$I_{L_{1P}}(t)$: $u \approx 0$ cost $\rightarrow H=0$

$I_{L_{0A}}(t)$: $\frac{E_0}{R_1} = K$

$\rightarrow \bar{I}_L(t) = \frac{E_0}{R_1} e^{-\frac{10R_2}{L}t} = 10 e^{-10^6 t} \rightarrow V_L(t) = L\frac{dI_L}{dt} = 10^{-3}(-10^7)e^{-10^6 t} = -10^4 e^{-10^6 t}$

$\rightarrow V_2(t) = \frac{1}{10}V_L = -10^3 e^{-10^6 t} \rightarrow E_{R_2}^{MAX} = \frac{1}{2} L I_L^{Max\,2} = \frac{1}{20}$ J

ES.3



det impedenza tra A-B. $\bar{E} = 10V, \omega = 1kHz$

det $\bar{I}_4$ fasore.

$\rightarrow L = j\omega L \quad C = \frac{1}{j\omega C}$

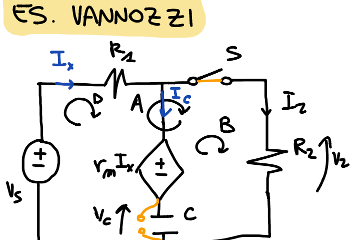
$\rightarrow \bar{X} = 0$ per KVL A $\rightarrow$ impedenza nulla

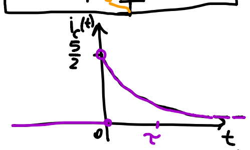
$\rightarrow$ in B: $Z_{eq} = \frac{R_1}{1+j\omega C R_1}$ $(R_1 // C_1)$

$\bar{\omega} = \frac{E}{Z_{eq}} = \frac{ER_1}{1+j\omega CR_1} \rightarrow \bar{y} = -R_2\bar{\omega}$ (per KVL) $\rightarrow \bar{y} = \frac{-R_2R_1\bar{E}}{1+j\omega CR_1} = \bar{I}_4 R_4$

$\rightarrow \bar{I}_4 = -\frac{R_2R_1\bar{E}}{R_4 + j\omega C R_1 R_4}$

ES. VANNOZZI





$R_1 = R_2 = 2\,\Omega \quad C = \frac{1}{5}F \quad r_m = 3\,\Omega \quad V_s = 10\,V$

$\forall\, t<0$ S chiuso. Det eq. stato, $v_c(t)$ e $I_c(t)$

$\rightarrow$ S chiuso a regime $\rightarrow$ cond. C.A.

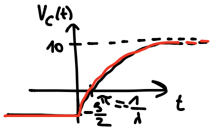
KVL A) $V_s = I_x(R_1+R_2) \rightarrow I_x = \frac{V_s}{R_1+R_2}$ (a 0^-)

KVL B) $V_c = \frac{R_2V_s}{R_1+R_2} - r_m I_x = \frac{(R_2-r_m)V_s}{R_1+R_2} = \frac{(2-3)10}{4} = -\frac{5}{2} \rightarrow V_c$ a $t=0^-$

so che : $I_c = C\frac{dV_c}{dt}$ $\wedge$ $V_c(0^-)=V_c(0^+)=-\frac{5}{2}$

$\to$ S si apre: $I_x = I_c$

KVL D) $V_s - I_x R_1 - r_m I_x - V_c = 0$



$\to V_c(t) = V_s - C\frac{dV_c}{dt}(R_1+r_m) \to \frac{dV_c}{dt} = -\frac{V_c(t)}{(R_1+r_m)C} + \frac{V_s}{(R_1+r_m)C}$

se >0 a ∞ non raggiunge nuovo reg.

u

$\hookrightarrow$ eq. di stato

oppure

$$\dot{V}_c(t) + \frac{V_c(t)}{(R_1+r_m)C} - \frac{V_s}{(R_1+r_m)C} = 0$$

$\to u$ cost $\to$ cerco $V_{c_{ip}}(t)$: $0 = -\frac{1}{(R_1+r_m)C}V_{c_{ip}}(t) + \frac{V_s}{(R_1+r_m)C}$

$\hookrightarrow V_{c_{ip}}(t) = V_s$

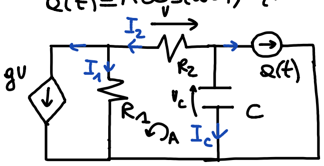
$\to$ cerco $V_{c_{0A}}(t)$: $-\frac{5}{2} = K + 10 \to K = -\frac{25}{2}$

$V_c(t) = -\frac{25}{2}e^{-t} + 10$ so che $i_c(t) = C\frac{dV_c}{dt} = C\left(\frac{25}{2}e^{-t}\right) = \frac{5}{2}e^{-t}$

pongo qui $V_c(t)$

Es. 8.15

$a(t) = A\cos(\omega t)$, $V_c(0) = 0\,V$ (h : $g < \frac{R_1+R_2}{R_1R_2}$)



$\to$ eq. di stato $\to$ cerco rel V_c e I_c

$I_2 = -(a(t) + I_c)$

KVL A) $V_c - V - R_1 I_1 = 0 \to V_c - I_2R_2 - R_1(I_2 - gR_2I_2) = 0$

$\to V_c = I_2(R_2 + R_1 - gR_2R_1)$

da KCL $\to V_c = (a(t) + I_c)(R_2+R_1-gR_2R_1)$

$V_c = -a(t)(R_2+R_1-gR_2R_1) - C\frac{dV_c}{dt}(R_2+R_1-gR_2R_1)$

$\to \frac{dV_c}{dt} = -\frac{V_c(t)}{C(R_2+R_1-gR_2R_1)} - \frac{a(t)}{C}$

$\to$ ricavo $V_{c_{ip}}(t)$: $\frac{dV_{c_{ip}}}{dt} = -\frac{V_{c_{ip}}(t)}{C(\sim\sim)} - \frac{a(t)}{C} \longrightarrow j\omega\bar{V}_c = -\frac{\bar{V}_c}{C(\sim)} - \frac{\bar{A}}{C}$

$\to j\omega\bar{V}_c = -\frac{1}{CR_{eq}}\bar{V}_c - \frac{\bar{A}}{C} \to \frac{(j\omega CR_{eq}+1)\bar{V}_c}{j\omega CR_{eq}} = -\frac{\bar{A}}{C}$

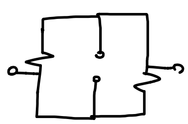
$\to \bar{V}_c = \frac{-A(j\omega CR_{eq})}{1+j\omega CR_{eq}} =$

Es. 8.13

impedenze: $C = \frac{1}{j\omega C}$; $L = j\omega L$; R

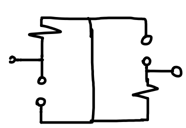
se $\omega = 0 \to C = \infty$; $L = 0$ $\to$

$\downarrow$ C.A. $\hookrightarrow$ C.C.



$\to Z_{eq} = R_1 // R_2 = \frac{R_1R_2}{R_1+R_2}$

se $\omega = \infty \to C = 0$; $L = \infty \to$



$\to Z_{eq} = R_1 + R_2$

Es. 8.3

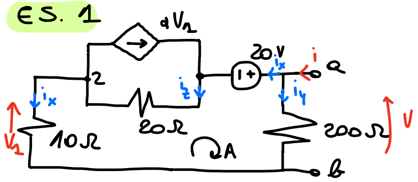
R_{eq} con C a R_2 e O $\to Z_{eq} = R_1 + j\omega L$

per $\omega = 0 \to$ puramente resistiva

$\nexists\ \omega \in \mathbb{R}$ tc res. solo induttiva

APPELLO SETT. 2017

ES. 1



eq. Thevenin e Norton. Per quali α non esistono?

→ prove semplici:

$V = R_{Th} i + E_{Th}$

→ spengo gen. ind e trovo R_{Th}:

→ $200 \,//\, (\text{tutto}) \rightarrow V_{Th} = 200\, i_y = 200(i - i_x)$

→ $i_2 = i_x + \alpha V_1$: KVL A) $20 - 200(i - i_x) + 10 i_x + 20(i_x + \alpha V_1) = 0$

$\rightarrow 20 - 200 i + 200 i_x + 10 i_x + 20 i_x + 200\alpha\, i_x = 0$

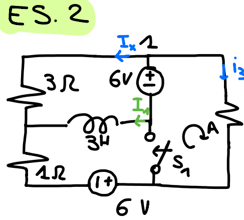
$\rightarrow (230 + 200\alpha) i_x = -20 + 200 i \rightarrow i_x = \dfrac{-20 + 200 i}{230 + 200\alpha}$

$$V_{Th} = 200\left(i + \frac{20}{230+200\alpha} - \frac{200 i}{230+200\alpha}\right) = 200 i + \frac{20 \cdot 200}{\cancel{200}\left(\frac{230}{200}+\alpha\right)} - \frac{200 \cdot \cancel{200} i}{\cancel{200}\left(\frac{230}{200}+\alpha\right)} =$$

$$= \frac{230 + 200\alpha - 200}{''} i + '' = \underbrace{\frac{30 + 200\alpha}{\frac{230}{200}+\alpha}}_{R_{Th}} i + \underbrace{\frac{20}{\frac{230}{200}+\alpha}}_{E_{Th}} \rightarrow \exists \text{ sse } \alpha \neq -\frac{230}{200}$$

$$i_{nr} = \frac{1}{R_{Th}} V + \frac{20}{\cancel{\frac{230}{200}+\alpha}} \cdot \frac{\cancel{230\ldots}}{30+200\alpha} = \frac{V}{R_{Th}} + \underbrace{\frac{20}{30+200\alpha}}_{A_{nr}} \rightarrow \exists \text{ sse } \alpha \neq -\frac{30}{200}$$

ES. 2



$I_1(0) = 2\,A \rightarrow S_1$ si chiude a $t = \log(4)$

Det $I_1(t)$ e $I_3(t)$ per $t \geq 0$.

→ $0 \leq t < \log 4_1$ S_1 è aperto

ipotizzo che a $t=0$ si apra

→ KVL A) $6 - 2 i_3 - 6 - 1 i_3 + V_L = 0 \rightarrow V_L = 3 i_3$

KCL 1) $I_3 = I_1 - I_x$

cerco I_x: $6 - 3 I_x + V_L = 0 \rightarrow I_x = \frac{V_L}{3} + 2$

$\rightarrow V_L = 3\left(-I_1 - \frac{V_L}{3} - 2\right) \rightarrow 2 V_L = -3 I_1 - 6 \rightarrow V_L = -\frac{3}{2} I_1 - 3 \rightarrow \frac{dI_1}{dt} = -\frac{3}{2 \cdot 3} I_1 - 1$

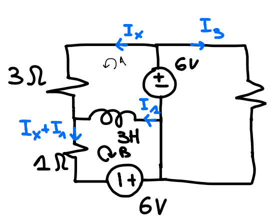
$\rightarrow \frac{dI_1}{dt} = -\frac{1}{2} I_1 - 1$ eq. di stato tra $0 < t \leq \log 4$

cerco $I_{1p}(t)$: u cost $\rightarrow 0 = -\frac{1}{2} I_p - 1 \rightarrow I_{1p} = -2$

cerco $I_{on}(t)$: $2 = k - 2 \rightarrow k = 4$

$\rightarrow I_1(t) = 4 e^{-\frac{t}{2}} - 2 \rightarrow$ quando $t = \log 4$: $I_1(t) = 4 e^{-\frac{\log 4}{2}} - 2 = 4 \cdot \frac{1}{2} - 2 = 0$ $\log 4^{-\frac{1}{2}}$

→ per $t \geq \log 4$ S_1 si chiude $I_1(\log 4) = 0$



KVL A) $6 - 3 I_x + V_L = 0 \rightarrow V_L = 3 I_x - 6$

cerco rel $I_x - I_1$: KVL B) $V_L - 6 + (I_x + I_1) = 0$

$\rightarrow I_x = -I_1 - V_L + 6$

$\rightarrow V_L = 3(-I_1 - V_L + 6) - 6 = -3 I_1 - 3 V_L + 18 - 6$

$\rightarrow 4 V_L = -3 I_1 + 12 \rightarrow V_L = -\frac{3}{4} I_1 + 3$

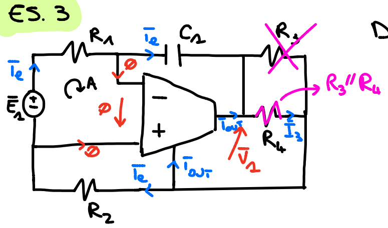
→ eq di stato : $\frac{dI_1}{dt} = -\frac{1}{4} I_1 + 1$

$I_{1p}(t)$: u cost $\rightarrow$ $0=-\frac{1}{4}H+1$ $\rightarrow$ $H=4$

$I_{0A}(t)$: $0=K+4$ $\rightarrow$ $K=-4$ $\qquad \rightarrow I_1(t)=-4e^{-\frac{(t-\log 4)}{4}}+4$

cerco $I_3(t)$: $I_3=\frac{6}{2}=3$ A fissa

ES. 3



Det $p(\omega)=\frac{\bar V_1}{\bar E_1}$ e $\hat S_{A0}$ (hp: fasori rispetto a val max)

KVL A) $\bar E_1 - R_1\bar I_e = 0 \rightarrow \bar I_e = \frac{\bar E_1}{R_1}$

KVL attorno OA) $\bar E_1 - \bar I_e R_1 - \frac{1}{j\omega C_1}\bar I_e - \bar V_1 - R_2\bar I_e = 0 \rightarrow \bar V_1 = E_1 - \left(R_1+R_2+\frac{1}{j\omega C}\right)\frac{\bar E_1}{R_1}$

$$p(\omega)=\frac{\bar V_1}{\bar E_1} = 1-\left(R_1+R_2+\frac{1}{j\omega C}\right)\frac{1}{R_1} = \frac{1}{R_1}\left(R_2+\frac{1}{j\omega C_1}\right)$$

$\rightarrow \hat S_{A0} = \frac{1}{2}\bar V_1 \bar I_3^*$ trovo $\bar I_3 = \frac{\bar V_1(R_3+R_4)}{R_3R_4} + \frac{\bar E_1}{R_1} = \frac{R_3+R_4}{R_3R_4}\left(E_1 - \left(R_1+R_2+\frac{1}{j\omega C}\right)\frac{E_1}{R_1}\right) + \frac{\bar E_1}{R_1}$ $\rightarrow$ trovo $\bar I_3^*$ e sostituisco

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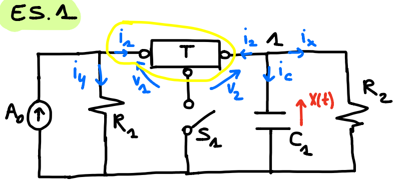
2 ITE. LUGLIO 2016

ES. 1



S_1 è aperto, A_0 = cost. Det eq di stato

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} \alpha & \alpha \\ \alpha & \alpha \end{bmatrix}\begin{bmatrix} i_1 \\ i_2 \end{bmatrix} \rightarrow T_1$$

cerco i_c in funz V_c: KCL 1) $i_c = -i_2 - i_x = -i_2 - \frac{V_c}{R_2}$

$\hookrightarrow i_c = i_1 - \frac{V_c}{R_2}$

KCL Σ) $I_1 = -I_2$

$\hookrightarrow A_0 - i_4 = +i_x + i_c \rightarrow A_0 + \frac{V_c}{R_1} = \frac{V_c}{R_2} + i_c \rightarrow i_c = \left(\frac{1}{R_1}-\frac{1}{R_2}\right)V_c + A_0 \rightarrow \frac{dV_c}{dt} = \left(\frac{R_2-R_1}{R_1R_2}\right)\frac{V_c}{C_1} + \frac{A_0}{C_1}$

$\left.\begin{array}{l} V_1 = \alpha I_1 - \alpha I_1 = 0 \\ V_2 = \alpha I_1 - \alpha I_2 = 0 \end{array}\right\} \rightarrow V_{R_2} = x(t)$

ES. 2

$t_0=0^-$ S_1 chiuso $\rightarrow$ x(t) per $t\geq 0^+$

in $t_0=0^-$ regime: $C_1 \rightarrow$ c.a. $\quad A_0 - i_1 = \frac{V_1}{R_1}$ $\quad$ mentre $i_2 = \frac{-V_2}{R_2}$ ($i_c=0$)

$V_1=V_2$ $\quad \rightarrow i_1 = A_0 - \frac{V_2}{R_1}$; $i_2 = -\cancel{i_1} = -\frac{V_2}{R_2}$ $\rightarrow V_2 = \alpha\left(A_0 - \frac{V_2}{R_1} - \frac{V_2}{R_2}\right) \rightarrow V_c = V_2 = \frac{\alpha A_0 R_1R_2}{R_1R_2+\alpha(R_1+R_2)}$ $\rightarrow$ $t=0^-$

$t\geq0^+ \rightarrow V_c(0^+) = \frac{\alpha A_0R_1R_2}{R_1R_2+\alpha(R_1+R_2)}$

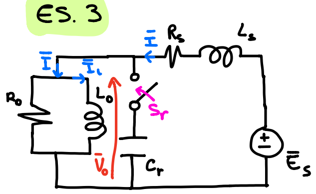
si apre e uso eq. di stato prec. $\rightarrow \frac{dV_c}{dt} = \left(\frac{R_2-R_1}{R_1R_2}\right)\frac{V_c}{C_1}+\frac{A_0}{C_1}$

$V_{c_{1p}}(t)$: u cost $\rightarrow 0 = \frac{R_2-R_1}{R_1R_2C}H + \frac{A_0}{C_1} \rightarrow H = -\frac{A_0}{\cancel{C_1}}\cdot\frac{R_1R_2\cancel{C_1}}{R_2-R_1} = -\frac{A_0R_1R_2}{R_2-R_1}$

$V_{C_{0A}}(t)$: $\frac{\alpha A_0 R_1 R_2}{R_1R_2+\alpha(R_1+R_2)} = k - \frac{A_0 R_1 R_2}{R_2 - R_1} \rightarrow k = A_0 R_1 R_2 \left(\frac{\alpha}{n} + \frac{1}{R_2-R_1}\right)$

$\rightarrow V_c(t) = k\, e^{\frac{R_2-R_1}{R_1R_2C_1}t} - \frac{A_0 R_1 R_2}{R_2 - R_1}$

ES. 3



S_r è aperto. Det $\bar{V}_0 (= \bar{V}_L)$

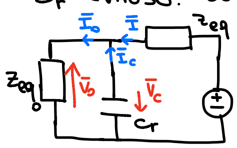
$\rightarrow \bar{V}_0 = R_s \bar{I} + j\omega L_s \bar{I} - \bar{E}_s = (R_s + j\omega L_s)\bar{I} - \bar{E}_s$

$Z_{eq} = \frac{j\omega L_0 R_0}{R_0 + j\omega L_0} = \frac{\bar{V}_0}{\bar{I}} \rightarrow \bar{I} = \frac{R_0 + j\omega L_0}{j\omega L_0 R_0}\bar{V}_0$

$\rightarrow \bar{V}_0 = \frac{(R_s + j\omega L_s)(R_0 + j\omega L_0)}{j\omega L_0 R_0}\bar{V}_0 - \bar{E}_s \rightarrow \bar{V}_0 = \frac{j\omega L_0 R_0}{R_s R_0 + \omega^2 L_0 L_s + j\omega(L_0 R_s + L_s R_0 - L_0 R_0)}\bar{E}_s$

ES. 4

S_r chiuso. $\omega = 1$ rad/s, $R_0 = 2\,\Omega$, $R_s = 1\,\Omega$, $L_0 = 1$ H, $L_s = 1$ H. Det C_r t.c. P solo reale



$Z_{eq_0} = \frac{2j\cdot 1\cdot 1}{2+j\cdot 1\cdot 1} = \frac{2j}{2+j}$ $\qquad Z_{eq_1} = 1 + j\cdot 1\cdot 1 = 1+j$

$\rightarrow \frac{2j}{2+j}\cdot\frac{2-j}{2-j} = \frac{2+j4}{4+1} = \frac{2+4j}{5} \;//\; \frac{1}{jC_r}$ $(\omega = 1)$

$Z_{eq} = \frac{\left(\frac{2+4j}{5}\right)\frac{1}{jC_r}}{\frac{2+4j}{5} + \frac{1}{jC_r}} = \frac{2+4j}{5-4C_r+j2C_r}$ in serie con $Z_{eq_1} \rightarrow \frac{2+4j}{-3+j2C_r}\cdot\frac{3+j2C_r}{3+j2C_r}$

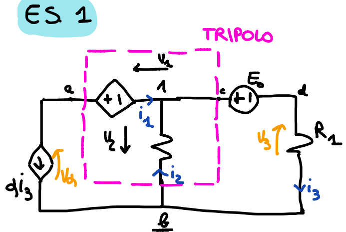
va cambiato ovunque

$\rightarrow \frac{6-8C_r+j(4C_r+12)}{-9-2C_r} + 1 + j = \frac{6-8C_r+j(\sim)-9-2C_r-9j-j2C_r}{-9-2C_r}$ $\qquad \rightarrow \frac{6+j4C_r+12j-8C_r}{-9-2C_r}$

$\longrightarrow \mathrm{Im}(Z_{eq}) = 0 \rightarrow \frac{4C_r+12-9-2C_r}{-9-2C_r} = 0 \longrightarrow 2C_r = -3 \rightarrow C_r = -\frac{3}{2}$

PRIMA ITINERE MAGGIO 2016

ES. 1



metodo potenziali di nodo. Det u_c con $u_g = 0$

$$\begin{bmatrix} V_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} 0 & \alpha \\ 0 & g \end{bmatrix}\begin{bmatrix} i_1 \\ V_2 \end{bmatrix}$$

$u_d = u_c - E_0$

$\rightarrow V_3 = u_d \qquad E_0 = u_c - u_d \qquad V_4 = u_a = V_2 + V_1 \qquad V_2 = u_c$

KCL 1) $i_1 + i_2 = i_3 \rightarrow \alpha\frac{u_d}{R_1} + gu_c = \frac{u_d}{R_1} \rightarrow gu_c = \left(\frac{1}{R_1} - \frac{\alpha}{R_1}\right)u_d \rightarrow gu_c = \left(\frac{1-\alpha}{R_1}\right)u_d$

$\alpha\frac{V_3}{R_1} = \alpha i_3 \qquad gV_2 = gu_c$

$\hookrightarrow gR_1u_c = (1-\alpha)(u_c - E_0) \rightarrow (gR_1 - 1 + \alpha)u_c = (\alpha - 1)E_0$

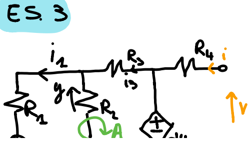
$\hookrightarrow u_c = \frac{(\alpha-1)E_0}{gR_1 - 1 + \alpha}$

ES. 2

S_T?

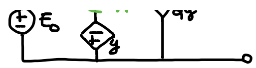
$\hookrightarrow P_{V_1} + P_{V_2} = S_T \rightarrow \alpha V_2 \cdot \alpha\frac{V_3}{R_1} + V_2 i_2 = S_T \rightarrow \alpha^2\frac{u_d}{R_1}\cdot u_c + gu_c^2 = S_T \rightarrow$

ES. 3



Det. eq. Thevenin tra A-B.

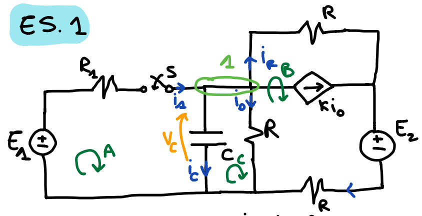
$\rightarrow V = R_{Th}i + E_{Th} \rightarrow V = R_4 i + \alpha y$ da KVL



$\hookrightarrow$ KVL A) $E_0 + R_1 i_1 + R_3 i_3 - \alpha y = 0 \rightarrow \alpha y = E_0 + R_1 i_1 + R_3 i_3$

SECONDA PROVA IN ITE. 2017

ES. 1



S è aperto e circuito a regime, $t<0$.
A $t=0$, interruttore S viene chiuso. Det. equazione di stato.

$\rightarrow$ RETE per $t \leq 0^-$:

$V_c = R i_0$

$\rightarrow i_R = \dfrac{V_c - E_2 - R\omega}{R}$

$\rightarrow t \geq 0^+$: cerco i_c in funz. di V_c

KCL 1) $i_c + i_0 + i_R + K i_0 = i_1 \rightarrow$

KVL A) $E_1 - R_1 i_1 - V_c = 0 \rightarrow i_1 = \dfrac{E_1 - V_c}{R_1}$

KVL B) $R i_0 - R i_R - E_2 - R(i_R + K i_0) = 0$

$\hookrightarrow R i_0 (1-K) - 2R i_R - E_2 = 0$

$\rightarrow V_c(1-K) - E_2 = 2R i_R$

$\hookrightarrow i_R = \dfrac{V_c(1-K) - E_2}{2R}$

KVL C) $V_c = R i_0 \rightarrow i_0 = \dfrac{V_c}{R}$

Sost in KCL 1) $i_c + \dfrac{V_c}{R} + \dfrac{V_c(1-K) - E_2}{2R} + K\dfrac{V_c}{R} = \dfrac{E_1 - V_c}{R_1}$

$$\hookrightarrow i_c = -\frac{(1+K)V_c}{R} - \frac{(1-K)V_c}{2R} - \frac{V_c}{R_1} + \frac{E_2}{2R} + \frac{E_1}{R_1} = -\frac{2R_1(1+K) + R_1(1-K) + 2R}{2RR_1} V_c + \frac{R_1 E_2 + 2R E_1}{2RR_1}$$

$$\hookrightarrow \dot{V}_c = -\frac{3R_1 + R_1 K + 2R}{2RR_1 C} V_c + \frac{R_1 E_2 + 2R E_1}{2RR_1 C}$$

eq. di stato

ES. 2

Det K in modo che per $t>0$ operi a regime.

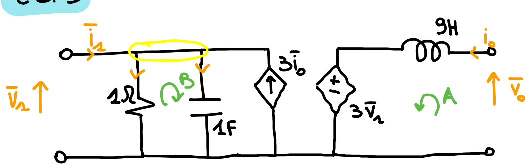
$\rightarrow i_c = C\dfrac{dV_c}{dt} \rightarrow i_c = 0$ sse $\dfrac{dV_c}{dt} = 0$

inoltre per $t=0^+ \rightarrow V_c = E_1$ perché $i_1 = 0$ (non so perché)

$$\hookrightarrow \frac{3R_1 + R_1 K + 2R}{2RR_1 C} E_1 = \frac{R_1 E_2 + 2R E_1}{2RR_1 C} \rightarrow 3R_1 + R_1 K + 2R = \frac{R_1 E_2 + 2R E_1}{E_1} \rightarrow \cancel{R_1} K = \frac{\cancel{R_1} E_2}{E_1} \cancel{+2R} - 3\cancel{R_1} \cancel{-2R}$$

$$\hookrightarrow K = \frac{E_2}{E_1} - 3$$

ES. 3



Reg. sinusoidale permanente. Pulsazione ω.

$$\begin{bmatrix} \bar{V}_0 \\ \bar{I}_1 \end{bmatrix} = \begin{bmatrix} h_{11}(\omega) & h_{12}(\omega) \\ h_{21}(\omega) & h_{22}(\omega) \end{bmatrix} \begin{bmatrix} \bar{I}_0 \\ \bar{V}_1 \end{bmatrix}$$

$\rightarrow$ cerco $h_{11}(\omega)$ e $h_{12}(\omega)$ $\Big|_{\bar{I}_1 = 0}$

$h_{11}(\omega) = \dfrac{\bar{V}_0}{\bar{I}_0}\Big|_{\bar{V}_1 = 0} \rightarrow$ KVL A) $\bar{V}_0 - j\omega 9 \bar{I}_0 = 0 \rightarrow \bar{V}_0 = j9\omega \bar{I}_0 \rightarrow h_{11}(\omega) = j9\omega$

$h_{12}(\omega) = \dfrac{\bar{V}_0}{\bar{V}_1}\Big|_{\bar{I}_0 = 0} \rightarrow$ KVL A) $\bar{V}_0 - 3\bar{V}_1 = 0 \rightarrow h_{12}(\omega) = 3$

$\hookrightarrow$ induttanza non rilevante

→ cerco $h_{21}(\omega)$ e $h_{22}(\omega)\Big|_{\bar{V}_0=0}$

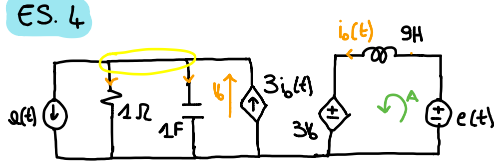
$h_{21}(\omega)=\frac{\bar{I}_1}{\bar{I}_0}\Big|_{\bar{V}_1=0}$ → KCL 3 → $\bar{I}_1+3\bar{i}_0=0 \rightarrow \bar{I}_1=-3\bar{i}_0 \rightarrow h_{21}(\omega)=-3$

KVL B → $R\bar{I}_R=\frac{1}{j\omega C}\bar{i}_c \rightarrow \bar{I}_R=\frac{1}{j\omega CR}\bar{i}_c \rightarrow V_R$ e V_c nulli perché // a V_1

$h_{22}(\omega)=\frac{\bar{I}_1}{\bar{V}_1}\Big|_{\bar{i}_0=0}$ → KCL 3 → $\bar{I}_1=\bar{I}_R+\bar{i}_c=\frac{\bar{V}_1}{R}+j\omega C\bar{V}_1=\left(\frac{1}{R}+j\omega C\right)\bar{V}_1$

↳ $h_{22}(\omega)=1+j\omega$

ES. 4



$a(t)=\cos(t)$; $e(t)=\cos(2t)$. Det $i_o(t)$

$\bar{a}=e^{j\cdot 0}=1$ A
$\bar{e}=e^{j\cdot 0}=1$ V
} pulsazioni differenti

→ cerco $\bar{I}_0\Big|_{\bar{a}=0}$: KVL A) $\bar{e}-j2\cdot 9\bar{I}_0-3\bar{V}_0=0 \rightarrow \bar{I}_{0,1}=\frac{1-3\bar{V}_0}{18j}$

KCL 3) $3\bar{i}_0-j\omega C\bar{V}_0-\frac{\bar{V}_0}{R}=0 \rightarrow \bar{V}_0=\frac{3}{1+j2}\bar{I}_0$

$\rightarrow \bar{I}_{0,1}=\frac{1}{18j}-\frac{3}{18j}\cdot\frac{3}{1+j2}\bar{I}_0 \rightarrow \left(1+\frac{3}{-4+4j}\right)\bar{I}_{0,1}=\frac{1}{18j} \rightarrow \bar{I}_{0,1}=\frac{\cancel{-4+4j}^{\,-2+2j}}{\cancel{18j}^{\,9}(-1+4j)}=\frac{-2+2j}{-36-9j}$

→ cerco $\bar{I}_0\Big|_{\bar{e}=0}$: $j9\bar{I}_{0,2}-3\bar{V}_0=0$ da KVL A

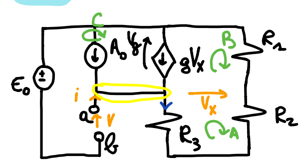
KCL 3) $\bar{a}+\frac{\bar{V}_0}{1}+j1\bar{V}_0-3\bar{I}_0=0 \rightarrow \bar{V}_0=\frac{3\bar{I}_0-1}{1+j}$

$\rightarrow 9j\bar{I}_0-\frac{9\bar{I}_0}{1+j}=\frac{-3}{1+j} \rightarrow \bar{I}_{0,2}=-\frac{\cancel{3}}{\cancel{1+j}}\cdot\frac{\cancel{1+j}}{\cancel{9j-18}}=-\frac{1}{3j-6}=\frac{1}{6-3j}$

→ sommo effetti: $\bar{I}_0=\frac{1}{6-3j}+\frac{-2+2j}{-36-9j}=\frac{-36-9j+(6-3j)(-2+2j)}{-216-54j+108j+27}$

APPELLO 15-02-18

N°1



Det. eq. Thevenin.

$V=R_{TH}i+E_{TH}$ $\qquad i_3=gV_x+A_0+i$

→ KVL A) $V_x=-(R_2+R_3)(gV_x+A_0+i)\rightarrow(1+gR_2+gR_3)V_x=-(R_2+R_3)(A_0+i)$

↳ $V_x=-\frac{R_2A_0+R_3i}{1+g(R_2+R_3)}$

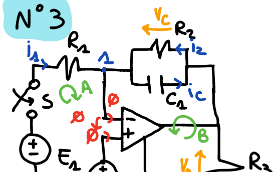
→ KVL B) $-V_x+V_g+R_1(gV_x+A_0+i)=0 \rightarrow V_g=-R_1A_0-R_1i-(1-R_1g)\frac{R_2A_0+R_3i}{1+g(R_2+R_3)}$

→ $V_g=-R_1(A_0+i)-(1-R_1g)\frac{R_2A_0+R_3i}{1+g(R_2+R_3)}$

→ KVL C) $V=E_0+R_1(A_0+i)+(1-R_1g)\frac{R_2A_0+R_3i}{1+g(R_2+R_3)}$

↳ $V=E_0+R_1A_0+R_1i+\frac{R_2A_0(1-R_1g)}{1+g(R_2+R_3)}+\frac{(1-R_1g)R_3i}{1+g(R_2+R_3)}=\left(R_1+\frac{(1-R_1g)R_3}{1+g(R_2+R_3)}\right)i+E_0+R_1A_0+\frac{R_2A_0(1-R_1g)}{1+g(R_2+R_3)}$

N°3



Circuito a regime, S è aperto. Per $t_0=0$, S viene chiuso.
$R_1=1$ kΩ; $R_2=2$ kΩ; $R_3=100\,\Omega$; $C_1=5\,\mu$F ; $E_2=2$ V; $E_1=10$ V.
→ eq. di stato per $V_c(t)$ e $V_0(t)$.

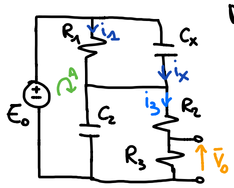
→ cerco i_c in funz. di V_c: KCL 1) $i_1+i_c=i_2$

$i_2=\frac{-V_c}{R_2}$; KVL A) $E_1-R_1i_1-E_2=0 \to i_1=\frac{E_1-E_2}{R_1}$

$i_c=i_2-i_1=-\frac{V_c}{R_2}-\frac{E_1-E_2}{R_1} \to \dot{V}_c=-\frac{V_c}{R_2C_1}-\frac{E_1-E_2}{R_1C_1} \to \dot{V}_c=-\frac{V_c}{10^2}-\frac{8}{10^3}$

→ cerco V_o in funz di V_c: KVL B) $V_o-V_c-E_2=0 \to V_o=V_c+E_2$ con V_c variabile nel tempo.

N°2



Det C_x t.c. $\bar{V}_o$ in fase con $\bar{E}_o$.

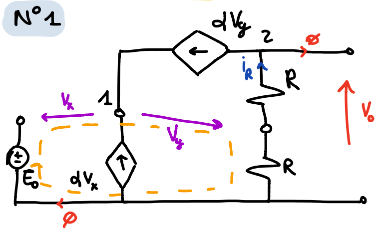
→ se $\bar{V}_o$ in fase con $\bar{E}_o$ → parte imm di $\bar{V}_o=0$ poiché $\varphi=0$

→ $\bar{V}_o=\bar{i}_3R_3$

KVL A) $\bar{E}_o-R_1\bar{i}_1-C_2(\bar{i}_1+\bar{i}_x+\bar{i}_3)=0 \to i_1=\frac{\bar{E}_o-C_2(\bar{i}_x+\bar{i}_3)}{R_1+C_2}$

APPELLO 07-17

N°1



Reg. stazionario. Det V_o (α noto)

→ KVL: $V_o=2Ri_R=2R\alpha V_y$

→ cerco i_R: KCL 1) $\alpha V_x=-\alpha V_y \to V_x=-V_y$

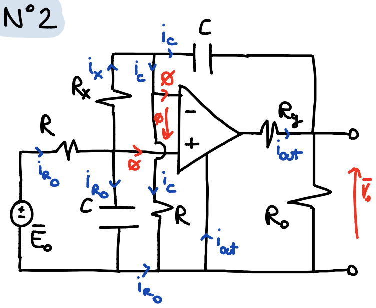
KCL 2) $i_R=\alpha V_y$

→ KVL: $E_o-V_x+V_y+R\alpha V_y=0 \to E_o+2V_y+R\alpha V_y=0$

→ $V_y=-\frac{E_o}{2+R\alpha}$

→ $V_o=2R\alpha\cdot\frac{E_o}{2+R\alpha}=\frac{2R\alpha E_o}{2+R\alpha}$

N°2



Det. $\bar{V}_o$. Reg sinusoidale perman. con ω_o.

→ $\bar{V}_o-\bar{i}_c\frac{1}{j\omega_0C}-R\bar{i}_c=0 \to \bar{V}_o=\left(\frac{1}{j\omega_0C}+R\right)\bar{i}_c$

→ grazie a KVL: $R_xi_x=0 \to i_x=0$

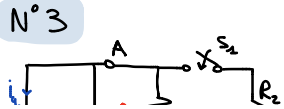
→ cerco i_c: KVL) $\bar{E}_o-\bar{i}_{R_o}R-\frac{1}{j\omega_0C}\bar{i}_{R_o}=0$

↳ $i_{R_o}=\frac{E_oj\omega_0C}{j\omega_0CR+1}$

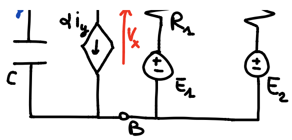
→ KVL: $\frac{1}{j\omega_0C}\bar{i}_{R_o}-\bar{i}_cR=0 \to \bar{i}_c=\frac{\bar{E}_o}{(j\omega_0CR+1)R}$

→ $\bar{V}_o=\left(\frac{1}{j\omega_0C}+R\right)\frac{\bar{E}_o}{(j\omega_0CR+1)R}=\frac{1+\cancel{Rj\omega_0C}}{j\omega_0C}\cdot\frac{\bar{E}_o}{(\cancel{j\omega_0CR+}1)R}=\frac{\bar{E}_o}{j\omega_0CR}$

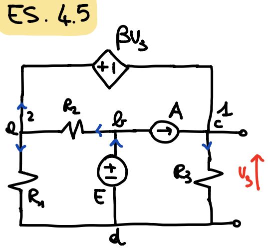
N°3



Det $v_x(t)$ per $t\geq0$.



ES. 4.5



$A = 6A$, $R_1 = 4\Omega$, $R_2 = 6\Omega$, $R_3 = 12\Omega$, $E = 12V$, $\beta = 2$. Det V_3?

ANALISI NODALE: $d = 0$ nodo di riferimento

$V_1 = a - d = a$ $\quad V_2 = a + b$ $\quad V_3 = C$ $\quad \beta V_3 = a - c$

$\hookrightarrow a = \beta V_3 + c = c(\beta + 1)$

$\rightarrow$ so che : $b = E$

KCL 1) $A + i_\beta - \frac{c}{R_3} = 0 \rightarrow c = R_3(A + i_\beta)$

KCL 2) $\frac{a}{R_1} + i_\beta - \frac{b-a}{R_2} = 0 \rightarrow i_\beta = \frac{E-a}{R_2} - \frac{a}{R_1} = \frac{E}{R_2} - \left(\frac{1}{R_2} + \frac{1}{R_1}\right)a$

$$\rightarrow V_3 = R_3\left(A + \frac{E}{R_2} - \left(\frac{1}{R_2} + \frac{1}{R_1}\right)V_3(\beta+1)\right) = 12\left(6 + \frac{12}{6} - \left(\frac{1}{6} + \frac{1}{4}\right)V_3(2+1)\right) = 12\left(8 - \frac{6+4}{24} \cdot 3V_3\right)$$

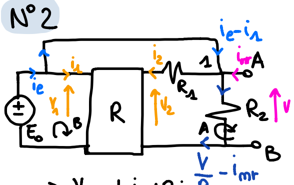
$$\rightarrow V_3 = 12 \cdot 8 - \frac{\overset{15}{\cancel{30}} \cdot \cancel{12}}{\cancel{24}\,\cancel{2}} V_3 \rightarrow 16 V_3 = 12 \cdot 8 \rightarrow V_3 = \frac{\overset{6}{\cancel{12}} \cdot \cancel{8}}{\cancel{16}\,\cancel{2}} = 6\,V$$

APPELLO LUGLIO 2019

N° 1

$A_0 = 10\,A$

N° 2



$R = \begin{bmatrix} 4 & 2 \\ 2 & 3 \end{bmatrix}$ $\quad \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = R \begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$ $\quad R_1 = 2\,\Omega$, $R_2 = 4\,\Omega$, $E_0 = 16V$. Det Norton

$i_{mr} = aV + B$

$\rightarrow V_1 = 4i_1 + 2i_2$ $\quad$ so che da KCL 1) $i_{mr} = i_2 - (i_e - i_1) - \frac{V}{R_2}$

$V_2 = 2i_1 + 3i_2$

$\rightarrow$ trovo i_2: KVL A) $V_2 + R_1 i_2 - V = 0 \rightarrow 2i_1 + 3i_2 + R_1 i_2 - V = 0 \rightarrow (3+2)i_2 = V - 2i_1 \rightarrow i_2 = \frac{V - 2i_1}{5}$

$\rightarrow$ KVL B) $E_0 - V_1 = 0 \rightarrow E_0 - 4i_1 - 2i_2 = 0 \rightarrow E_0 - 4i_1 - 2\frac{V-2i_1}{5} = 0 \rightarrow E_0 - \frac{2V}{5} = 4i_1 - \frac{4}{5}i_1 \rightarrow i_1 = \frac{5E_0 - 2V}{5}\frac{5}{16} = \frac{5E_0 - 2V}{16}$

$\rightarrow$

N° 3