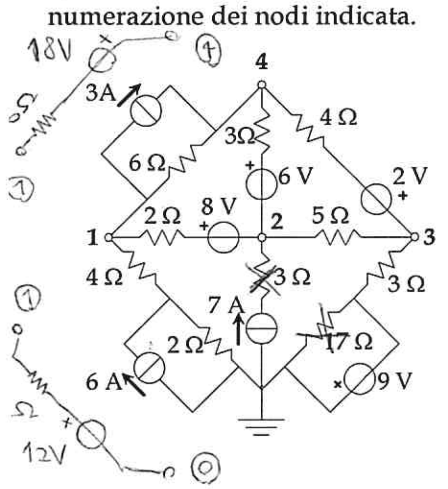
Elettrotecnica ed Elettronica applicata – Allievi Aerospaziali - Prof. Zich — Appello – 22/09/2014

Riportare su questo foglio i PASSAGGI PRINCIPALI e scrivere i risultati negli appositi riquadri — Tempo: 90 minuti

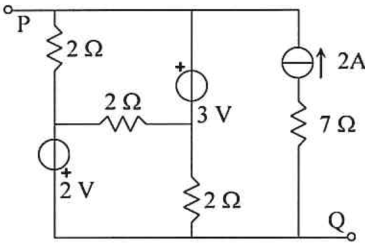
Cognome SOLUTIO	*Nome* SINE	*Matricola* QVA	NON

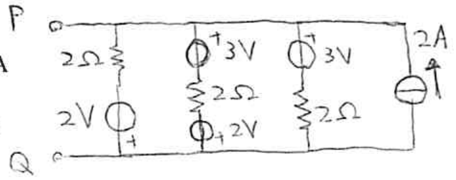
1) Scrivere il sistema risolvente la rete in Figura secondo il Metodo dei Nodi in forma matriciale facendo riferimento alla numerazione dei nodi indicata.



$$\underline{\underline{G}} = \begin{pmatrix} \frac{1}{6}+\frac{1}{2}+\frac{1}{6} & -\frac{1}{2} & 0 & -\frac{1}{6} \\ -\frac{1}{2} & \frac{1}{2}+\frac{1}{5}+\frac{1}{3} & -\frac{1}{5} & -\frac{1}{3} \\ 0 & -\frac{1}{5} & \frac{1}{3}+\frac{1}{5}+\frac{1}{4} & -\frac{1}{4} \\ -\frac{1}{6} & -\frac{1}{3} & -\frac{1}{4} & \frac{1}{6}+\frac{1}{3}+\frac{1}{4} \end{pmatrix} \qquad \underline{I} = \begin{pmatrix} \frac{12}{6}+\frac{8}{2}-\frac{18}{6} \\ 7-\frac{8}{2}-\frac{6}{3} \\ -\frac{9}{3}+\frac{2}{4} \\ \frac{18}{6}+\frac{6}{3}-\frac{2}{4} \end{pmatrix}$$

2) Calcolare l'equivalente **Norton** ai morsetti P-Q del circuito in figura



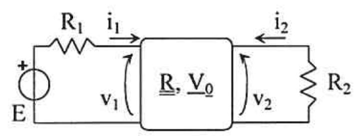


$$V_{PQ} = \frac{-\frac{2}{2}+\frac{1}{2}+\frac{3}{2}+2V}{\frac{1}{2}+\frac{1}{2}+\frac{1}{2}} = \text{''} = \frac{3V}{3/2} = 2V$$

$$R_{eq} = (2 // 2 // 2)\Omega = \frac{1\ \Omega}{\frac{1}{2}+\frac{1}{2}+\frac{1}{2}} = \frac{2}{3}\Omega; \quad I_{eq} = \frac{V_{eq}}{R_{eq}} = 3A$$

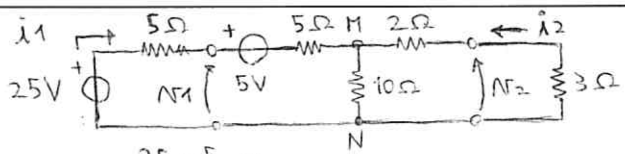
I_{eq} =	3 A
R_{eq} =	$\frac{2}{3}\Omega$

3) Calcolare V_1, V_2, I_1 e I_2



$$\underline{\underline{R}} = \begin{bmatrix} 15 & 10 \\ 10 & 12 \end{bmatrix} \quad \underline{V_0} = \begin{bmatrix} 5 \\ 0 \end{bmatrix}$$

E = 25V; R₁ = 5Ω; R₂ = 3Ω



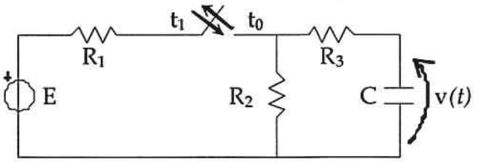
$$V_{MN} = \frac{\frac{25-5}{10}V}{\frac{1}{10}+\frac{1}{10}+\frac{1}{5}} = \frac{2V}{2/5} = 5V$$

$$i_1 = \frac{20V - V_{MN}}{10\Omega} = \frac{3}{2}A; \quad i_2 = \frac{-V_{MN}}{5\Omega} = -1A$$

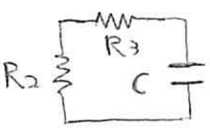
$$v_1 = 25V - 5\Omega \cdot i_1 = \frac{35}{2}V; \quad v_2 = -3\Omega \cdot i_2 = 3V$$

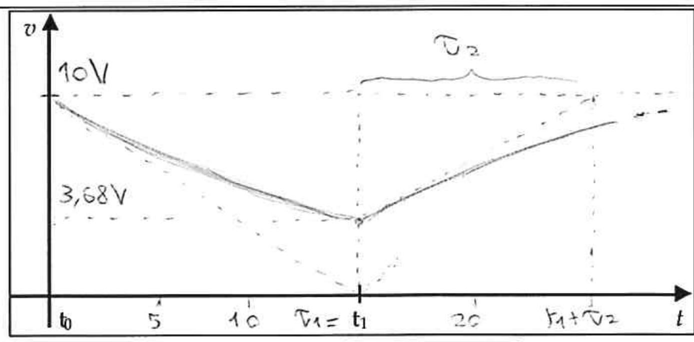
V_1 =	$\frac{35}{2}V = 17,5V$
V_2 =	3V
I_1 =	$\frac{3}{2}A = 1,5A$
I_2 =	−1 A

4) Calcolare τ_1, τ_2, $v(t_1)$ e diagrammare $v(t)$ per $t > 0$



APERTO





E = 20V

$R_1 = R_2 = 20\,\Omega$

$R_3 = 10\Omega$

C = 0,5F

$t_0 = 0s$

$t_1 = 15s$

$\tau_1 = (R_2 + R_3)\cdot C$

$\tau_1 = 30\Omega \cdot 0,5F = 15s$

$v_c(t) = v_c(0^-)\cdot e^{-\frac{t}{\tau_1}}$

CHIUSO

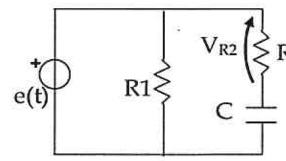
τ_1 = 15s	τ_2 = 10s
$v(t_1)$ =	3,68 V

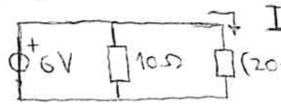
$$R_{eq} = R_3 + (R_1 // R_2) = 20\Omega \Rightarrow \tau_2 = 20\Omega \cdot 0,5F = 10s$$

$$V_{eq} = \frac{R_2}{R_1+R_2}E = \frac{1}{2}E = 10V \Rightarrow v_c(0^-) = 10V \Rightarrow v_c(t_1) = 10V\cdot e^{-\frac{15s}{15s}} \simeq 3,68V$$

$$v_c(t) = v_{c\infty} + (v_c(t_1) - v_{c\infty})\cdot e^{-\frac{(t-t_1)}{\tau_2}} = 10V - 6,32\cdot e^{-\frac{(t-15s)}{10s}} \quad \text{PER } t > t_1$$

5) Calcolare la tensione $v_{R2}(t)$, la potenza attiva assorbita dal resistore R1 e la potenza reattiva erogata dal generatore.





$v_{R2}(t) =$	$6V \cdot \cos(10^5 t + \frac{1}{4}\pi)$
$P_{R1} =$	3,6 W
$Q_{GEN} =$	0,9 VAR

R1 = 10 Ω; R2 = 20 Ω

C = 500 nF

$e(t) = 6\sqrt{2}\cos(10^5 t)$

$\tilde{I}_2 = \tilde{E} \cdot \frac{1}{R_2 - i\frac{1}{\omega C}} \Rightarrow \tilde{I}_2 = \frac{3A}{10(1-i)} = \frac{3(1+i)}{20} A$

$\tilde{V}_{R2} = R_2 \cdot \tilde{I}_2 = 20\Omega \cdot \frac{3}{20}(1+i)A = 3(1+i)V \qquad \tilde{V}_{R2} = 3\sqrt{2} \cdot e^{\frac{1}{4}\pi i}$

$v_{R2}(t) = 6V \cdot \cos(10^5 t + \frac{1}{4}\pi) \qquad P_{R1} = \frac{1}{R_1}|\tilde{E}|^2 = \frac{1}{10} \cdot (6)^2 W = 3,6 W$

$\tilde{E} = 6V;\ \omega C = 10^5 \cdot 5 \cdot 10^{-7} \Omega^{-1} \Rightarrow \frac{1}{\omega C} = 20\Omega$

$-iQ_{GEN} = \tilde{V}_C \cdot \tilde{I}_2^* = |\tilde{I}_2|^2 \cdot Z_C = (\frac{3}{20}\sqrt{2})^2 \cdot (-i20) VAR \Rightarrow Q_{GEN} = 0,9 VAR$

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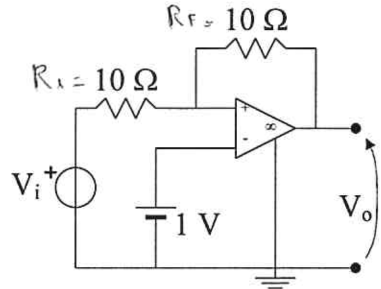
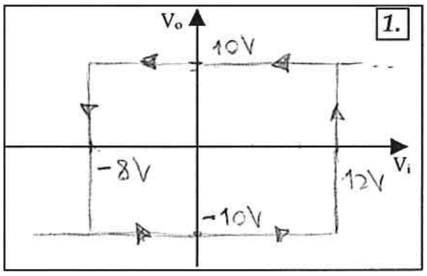
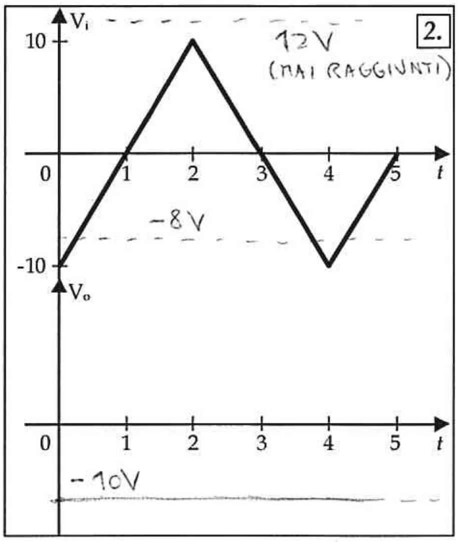
6) Calcolare e diagrammare:

1- la relazione ingresso-uscita del comparatore di soglia in figura

2- l'uscita $V_0(t)$ relativa all'ingresso $V_i(t)$ considerato. $E_s = 10$ V.







$V_+ = \frac{V_i/R_i + V_o/R_F}{1/R_i + 1/R_F} = \frac{\frac{1}{10}\cdot(V_i + V_o)}{\frac{1}{10}+\frac{1}{10}}$

$V_+ = \frac{1}{2}(V_i + V_o); \quad V_o = \pm E_s$

$V_d = V_+ - V_- = V_+ - 1V$

- SE $V_d > 0 \Rightarrow V_o = +E_s;\ V_+ > 1V \Rightarrow \frac{1}{2}(V_i + 10) > 1 \Rightarrow V_i > -8V$
- SE $V_d < 0 \Rightarrow V_o = -E_s;\ V_+ < 1V \Rightarrow \frac{1}{2}(V_i - 10) < 1 \Rightarrow V_i < 12V$

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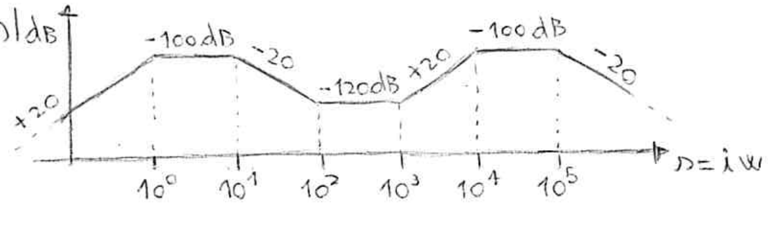
7) Disegnare il diagramma di Bode asintotico del modulo della seguente $H(s)$ e quotare <u>tutti</u> i tratti orizzontali:

$$H(s) = \frac{s^3 + 1100s^2 + 10^5 s}{(s+1)\cdot(s+10)\cdot(s+10^4)\cdot(s+10^5)}$$

$$H(s) = \frac{(s+10^{-\infty})\cdot(s+10^2)\cdot(s+10^3)}{(s+10^0)\cdot(s+10^1)\cdot(s+10^4)\cdot(s+10^5)}$$



$|H(i10^0)| \simeq \frac{10^0 \cdot 10^2 \cdot 10^3}{(\sqrt{2}\cdot 10^0)\cdot 10^1 \cdot 10^4 \cdot 10^5} = \frac{1}{\sqrt{2}} \cdot 10^{-5}$

$20 Log(|H(i10^0)|) = -20 Log(\sqrt{2}) + 20dB \cdot (-5) = -103\ dB$

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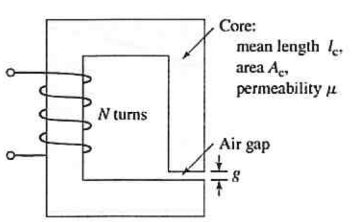
8) Si consideri il circuito magnetico riportato in figura. Calcolare i valori delle riluttanze R_c ed R_g, il flusso magnetico Φ e il valore di induttanza L.



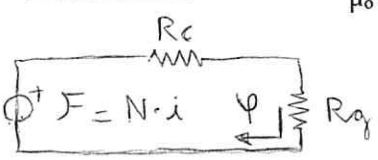
$A_c = 1.8 \cdot 10^{-3}\ m^2$
$l_c = 0.6$ m
$g = 2.3 \cdot 10^{-3}$ m
N = 83
I = 1.5 A
$\mu = 1500\ \mu_o$
$\mu_o = 4\pi \cdot 10^{-7}$ T·A/m

$R_c =$	176'836 A/Wb
$R_g =$	1'016'280 A/Wb
$\Phi =$	$1,043 \cdot 10^{-4}$ Wb
$L =$	$5,77 \cdot 10^{-3}$ H

$R_c = \frac{l_c}{A_c \cdot \mu} = 176'836\ A/Wb$

$R_g = \frac{g}{A_c \cdot \mu_o} = 1'016'280\ A/Wb$

$R_{TOT} = R_c + R_g = 1'193'116\ A/Wb$



$\varphi = \frac{N \cdot i}{R_{TOT}} = 1,043 \cdot 10^{-4}\ Wb; \quad L = \frac{\lambda}{i} = \frac{N\cdot\varphi}{i} = \frac{N^2}{R_{TOT}} = 5,77\ mH$