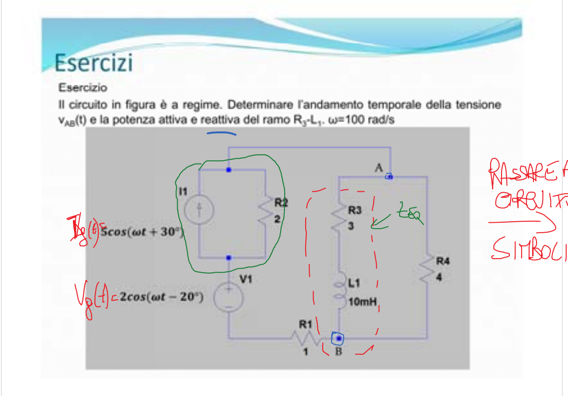
Esercitazione VIII -18 Maggio

martedì 18 maggio 2021 12:20



$I_g(t)$ 5cos(ωt + 30°), $V_g(t) = 2\cos(\omega t - 20°)$

PASSARE AL CIRCUITO SIMBOLICO

FASORI

$\bar{I}_g = 5e^{j30} = 5[\cos(30°) + j\sin(30°)]$

$\bar{I}_g = 4.33 + j2.5$ [A]

$\bar{V}_g = 2e^{-j20} = 2(\cos(20°) - j\sin(20°))$

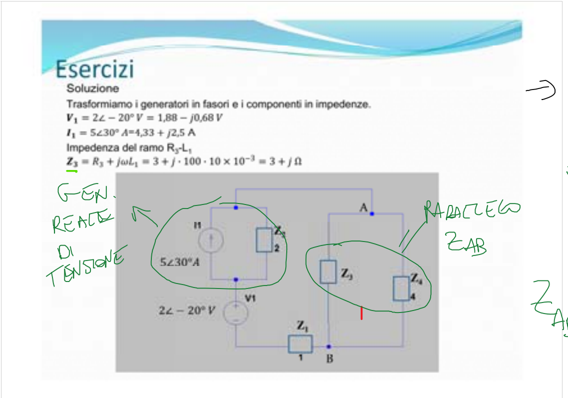
$\bar{V}_g = 1.88 - j0.68$ [V]

$Z_{R_2} = 2[\Omega]$

$Z_{R_3} = 3[\Omega]$ $\quad Z_{L_1} = j\omega L = j100 \text{ rad/s} \cdot 10 \cdot 10^{-3}$

$Z_{R_1} = 1[\Omega]$

$Z_{R_4} = 4[\Omega]$ $\quad Z_{L_1} = 1j\ [\Omega]$

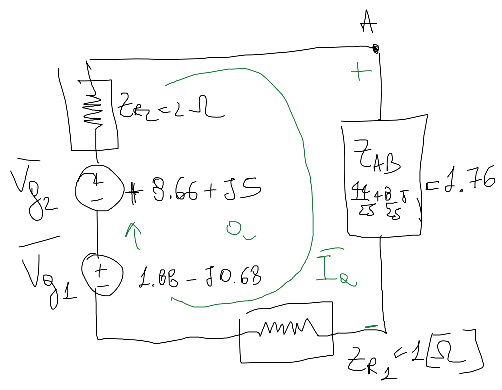


GEN. REALE DI TENSIONE — PARALLELO Z_{AB}

$Z_{EQ} = Z_{R_3} + Z_{L_1} = 3 + j$

$\bar{V}_{g_2} = \bar{I}_g \cdot Z_{R_2} = 4.33 + j2.5 [A] \cdot 2 = 8.66 + j5 [V]$

$Z_{AB} = Z_{eq} \| Z_4 = \frac{(3+j) \cdot 4}{7+j} = \frac{12+4j}{7+j} \cdot \frac{(7-j)}{(7-j)} = \frac{84 - 12j + 28j + 4}{49 + 1} = \frac{88 + 16j}{50} = \frac{44+8j}{25} [\Omega]$

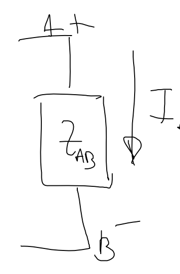


ⓐ $\bar{I}_a (Z_{R_2} + Z_{AB} + Z_{R_1}) - \bar{V}_{g_1} - \bar{V}_{g_2} = 0$

$\bar{I}_a = \frac{\bar{V}_{g_1} + \bar{V}_{g_2}}{Z_{R_2} + Z_{AB} + Z_{R_1}}$

$\bar{I}_a = \frac{1.88 - j0.68 + 8.66 + j5}{2 + 1.76 + j0.32 + 1} = \frac{10.44 + j4.32}{4.76 + j0.32} = \frac{(10.44 + j4.32)(4.76 - j0.32)}{(4.76 + j0.32)(4.76 - j0.32)}$

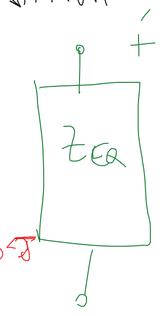
$= \frac{49.69 - j3.34 + j20.56 + 1.38}{22.75} = \frac{51.07 + j17.22}{22.75} = 2.24 + j0.75$ [A]



$\bar{V}_{AB} = Z_{AB} \cdot \bar{I}_{AB}$

$\bar{V}_{AB} = (2.24 + j0.75) \cdot (1.76 + 0.32j) = 3.94 + j0.7$

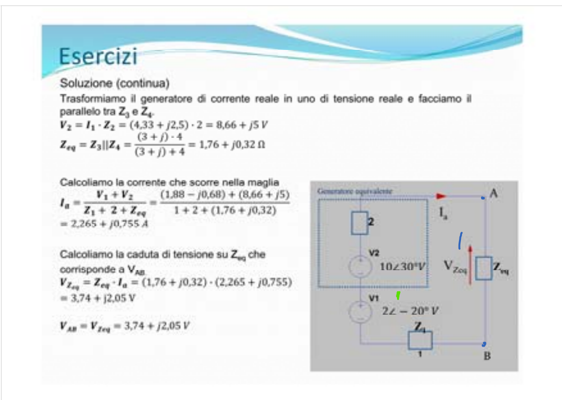
P_{ATTIVA} $\quad P_{REATTIVA}$?

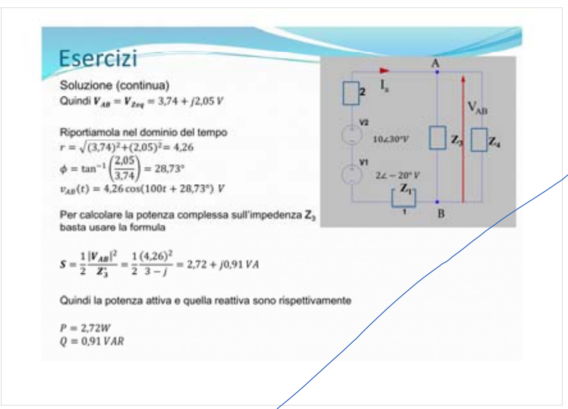


$Z_{EQ} = Z_{R_3} + Z_{L_1} = 3 + j$ ↳ $Z^*_{EQ} = 3 - j$

$\bar{S} = P + jQ = \frac{1}{2} \bar{V} \bar{I}^*$ (P ATTIVA, P REATTIVA)

$\bar{V} = Z \cdot \bar{I} \Rightarrow \frac{\bar{V}}{Z} = \bar{I}$ $\Rightarrow \bar{S} = \frac{1}{2} \frac{|V|^2}{Z^*_{EQ}} = \frac{3.70^2}{2}$





$\bar{I}_a = \bar{I}_g$

ⓑ $\bar{I}_b (Z_L) + (\bar{I}_b - \bar{I}_g) Z_R = 0$

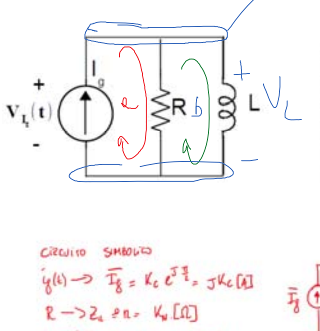
$\bar{I}_b = \frac{\bar{I}_g \cdot Z_R}{Z_L + Z_R} = \frac{30j}{6+4j} = \frac{15j}{3+2j} = 2.30 + j3.46 \Rightarrow \bar{V}_{I_g} = \bar{I}_b \cdot Z_L$

$= (2.30 + j3.46) \cdot 4j = 9.20j - 13.78 = -13.78 + 9.20j$ [V]

$\bar{S}_{V_g} = \frac{1}{2} \bar{V}_{I_g} \cdot \bar{I}_g^*$

$\bar{V}_g \rightarrow V_g(t) = Re\{\bar{V}_g e^{j\omega t}\} = |V_g| \cos(\omega t + \measuredangle(V_g))$ $\quad$ o $\tan\left\{\frac{Im\{V_g\}}{Re(V_g)}\right\}$

$\bar{S}_{I_g} = \frac{1}{2} \bar{V}_{I_g} \bar{I}_g^* = \frac{1}{2}(-13.78 + 9.20j)(-5j) = 34.45j + 23$ [VA]



Esercizio n° 2 (10 punti)

Il circuito in figura si trova in regime permanente sinusoidale.
Determinare: (1) la potenza complessa generata dal generatore di corrente; (2) la tensione $V_{Ig}(t)$ ai capi del del generatore di corrente $I_g(t)$
DATI: $I_g = k_C \cos(\omega t + 90°)$ [A], $R = k_N$ [Ω], L = 2 [mH], ω=2000 [rad/s]

$K_C = 5 \quad K_N = 6$

FASORI

$I_g(t) \rightarrow \bar{I}_g = 5e^{j90°} = 5(\cos(90) + j\sin(90)) = 5j$

$Z_R = 6[\Omega] \quad Z_L = j\omega L = j2 \cdot 10^3 \cdot 2 \cdot 10^{-3} = 4j$

$V_{I_g}(t) = |V_{I_g}| \cos(\omega t + ARG(\bar{V}_{I_g})) \Rightarrow \sqrt{13.78^2 + 9.20^2} = 16.57$ [V]

$\varphi_{I_g} = \arctan\left\{\frac{9.20}{-13.78}\right\} + 180° = 146.27°$

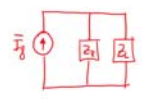
$V_{I_g}(t) = 16.57 \cos(\omega t + 146.27°)$ [V]

CIRCUITO SIMBOLICO

$i_g(t) \rightarrow \bar{I}_g = K_c e^{j\frac{\pi}{2}} = jK_c$ [A]

$R \rightarrow Z_R = K_N$ [Ω]

$L \rightarrow Z_L = j\omega L = j4$ [Ω]



PARTITORE DI CORRENTE

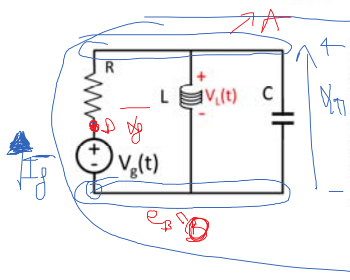
$Z_{eq} = \frac{Z_R Z_L}{Z_R + Z_L}$

$\bar{V}_{I_g} = \bar{I}_g \cdot Z_{eq} = jK_c \cdot \frac{K_N \cdot j4}{K_N + j4} = \frac{-4K_N K_c}{K_N + j4} =$

$\bar{S}_{I_g} = \frac{1}{2} \bar{V}_{I_g} \cdot \bar{I}_g^* = \frac{1}{2} \frac{-4K_N K_c}{K_N + j4} \cdot (-jK_c) = 2$

$= \frac{j2K_N K_c^2}{K_N + j4} = \frac{8K_N K_c^2 + j2K_N^2 K_c^2}{K_N^2 + 16}$ [W] + j [VA]

$v_{I_g}(t) = |\bar{V}_{I_g}| \cos(\omega t + Arg(\bar{V}_{I_g})) = \frac{4K_N K_c}{\sqrt{K_N^2 + 16}} \cos(\omega t + \pi - \arctan\frac{4}{K_N})$ [V]



Esercizio n° 2 (12 punti)

Il circuito in figura si trova in regime permanente sinusoidale.
Determinare: (1) la potenza apparente e il fattore di potenza del generatore di tensione $V_g(t)$; (2) la potenza complessa scambiata del condensatore C; (3) la tensione nel tempo $V_L(t)$ ai capi dell'induttore L.
DATI: $V_g(t) = k_N \text{sen}(\omega t)$ [V], R = 2 [Ω], L = k_C [mH], C = 500 [μF] ω=1000 [rad/s]

$K_N = 4 \quad K_C = 6$

FASORI

$\bar{V}_g = 4e^{-j\pi/2} = 4(\cos(90°) - j\sin(90)) = -4j$

$Z_R = 2\Omega \quad Z_L = j\omega L = j6$

$Z_C = \frac{1}{j\omega C} = \frac{1}{j1 \cdot 10^3 \cdot 500 \cdot 10^{-6}} = \frac{1}{j \cdot 0.5} = \frac{2}{j}$ $\quad Z_C = -2j$

$\bar{V}_{NL} = \bar{V}_L$

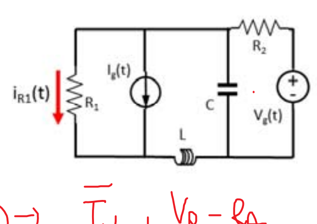
$\bar{V}_L = \bar{V}_C \Rightarrow$ $\quad \bar{V} = Z \cdot \bar{I} \quad \bar{S} = P + jQ = \frac{1}{2} V I^*$

$\bar{S}_C = \frac{1}{2} \frac{|V|^2}{Z^*}$

$\bar{S}_C = \frac{1}{2} \frac{10.95}{2j} \simeq -j2.75$ [VA]

Ⓐ $\frac{(e_A - V_g)}{Z_R} + \frac{e_A}{Z_L} + \frac{e_A}{Z_C} = 0$

$e_A \left(\frac{1}{Z_R} + \frac{1}{Z_L} + \frac{1}{Z_C}\right) = \frac{\bar{V}_g}{Z_R} \Rightarrow e_A = \frac{\bar{V}_g / Z_R}{\frac{1}{Z_R} + \frac{1}{Z_L} + \frac{1}{Z_C}} =$



Esercizio n° 2 (12 punti)

Il circuito in figura si trova in regime permanente sinusoidale.
Determinare: (1) la potenza apparente e il fattore di potenza del generatore di corrente $I_g(t)$; (2) verificate la conservazione della potenza attiva; (3) la corrente $i_{R1}(t)$ che scorre nella resistenza R_1.
DATI: $V_g(t) = k_C \cos(\omega t)$ [V], $I_g(t) = 3\cos(\omega t + \pi/2)$ [A], $R_1 = k_N$ [Ω], $R_2 = 3$ [Ω], L = 2 [mH], C = 100 [μF] ω=2000 [rad/s]

Ⓓ $-\bar{I}_{V_g} + \frac{V_g - e_A}{Z_R} = 0 \Rightarrow I_V = \frac{V_g - V_{Z_L}}{Z_R}$

$e_A = -1.84 - 2.76j$ [V] $= \bar{V}_L$

$V_L(t) = Re\{\bar{V}_L e^{j\omega t}\} = |V_L| \cos(\omega t + \measuredangle\{V_L\}) = 3.31\cos(\omega t + 56.30°)$

$I_V = \frac{V_g - V_{Z_L}}{Z_R} = \frac{(+1.84 + 2.76j) + (-4j)}{2} = \frac{+1.84 - 1.24j}{2} = 0.97 - 0.62j$

$P_{COMPLESSA\ V_g} = \frac{1}{2} V_g \cdot I^*_{V_g} = \frac{1}{2}(-4j) \cdot (0.97 + 0.62j) = 1.24 - 1.94j$ [VA]

$P.F. = \frac{Re\{S_{V_g}\}}{|S_{V_g}| \rightarrow P_{APPARENTE}} = \frac{P_{ATTIVA}}{|S_{V_g}|} = \frac{1.24}{2.30} = 0.53 = \cos\phi$

$1+j1.32-0.24 = \boxed{3.70+j2.03}$ [V]

$S = P + jQ$

$P_{ATTIVA} = Re\{\overline{S}\} = 2.67$ [W]

$\frac{+2.03^2}{(3-j)} = \frac{(6.85+2.06)}{3-j} \frac{(3+j)}{(3+j)} = \frac{20.55+6.18+6.85j+2.06j}{9+1} = \frac{26.73+j8.91}{10} = 2.67+0.89j$ [VA]

$P_{REATTIVA}$ [VAR]

0.89