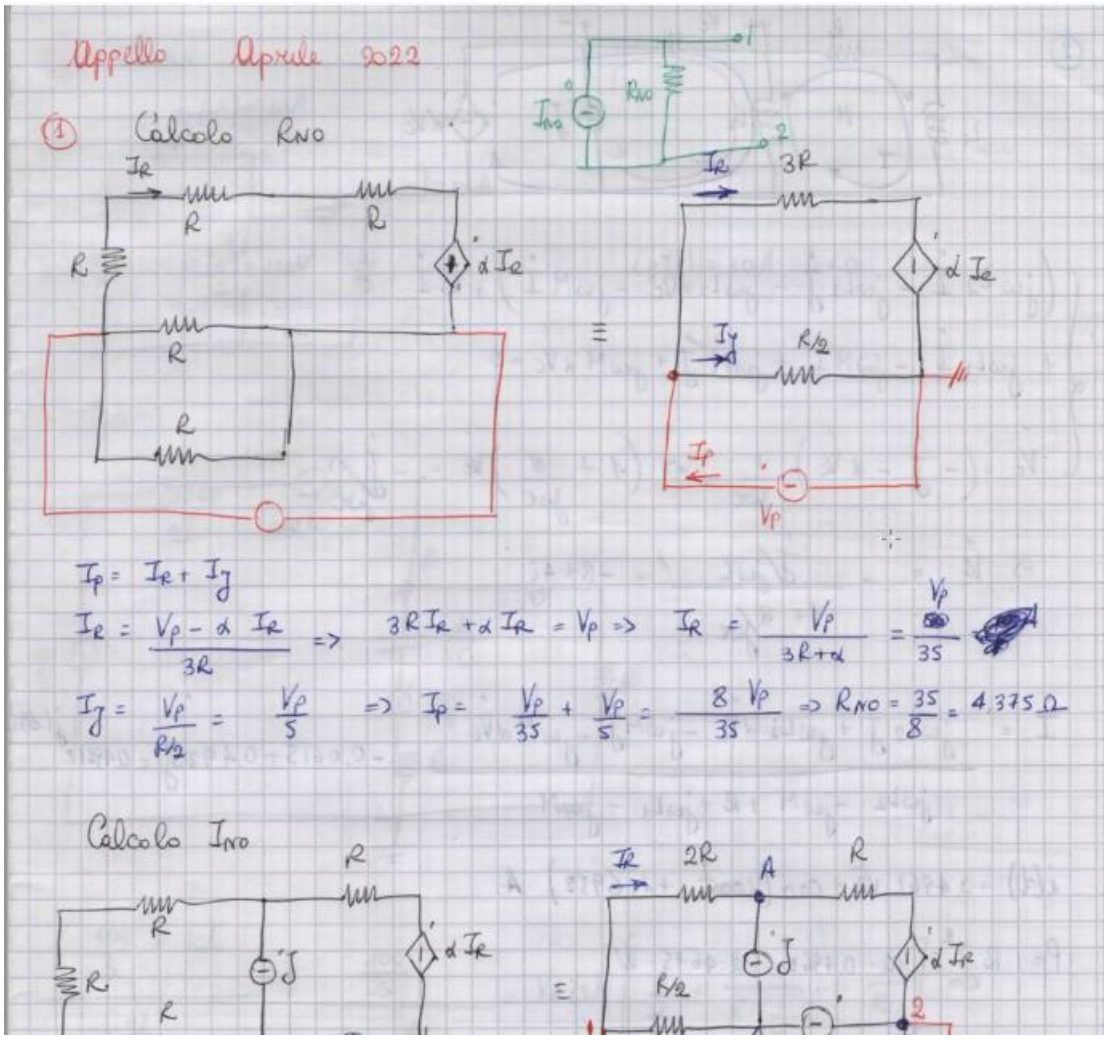
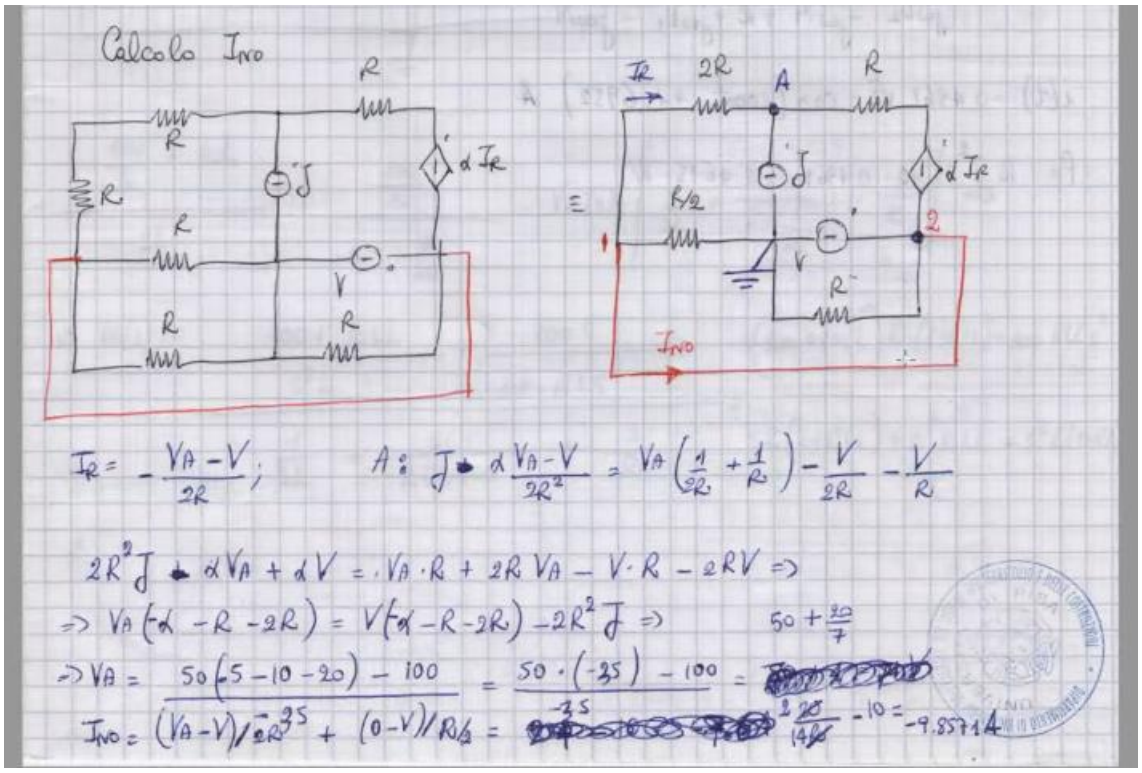
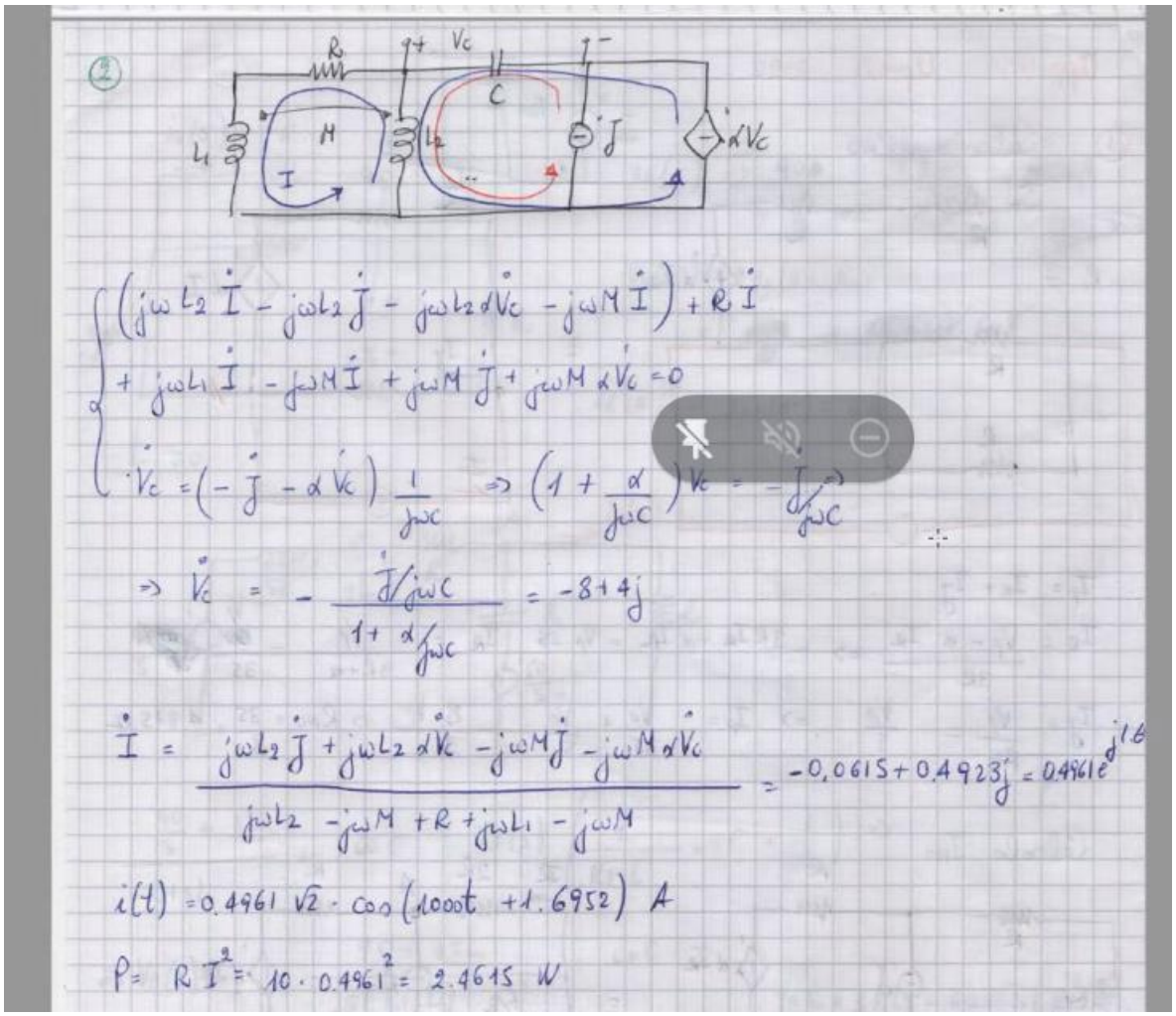
ESERCIZIO 1

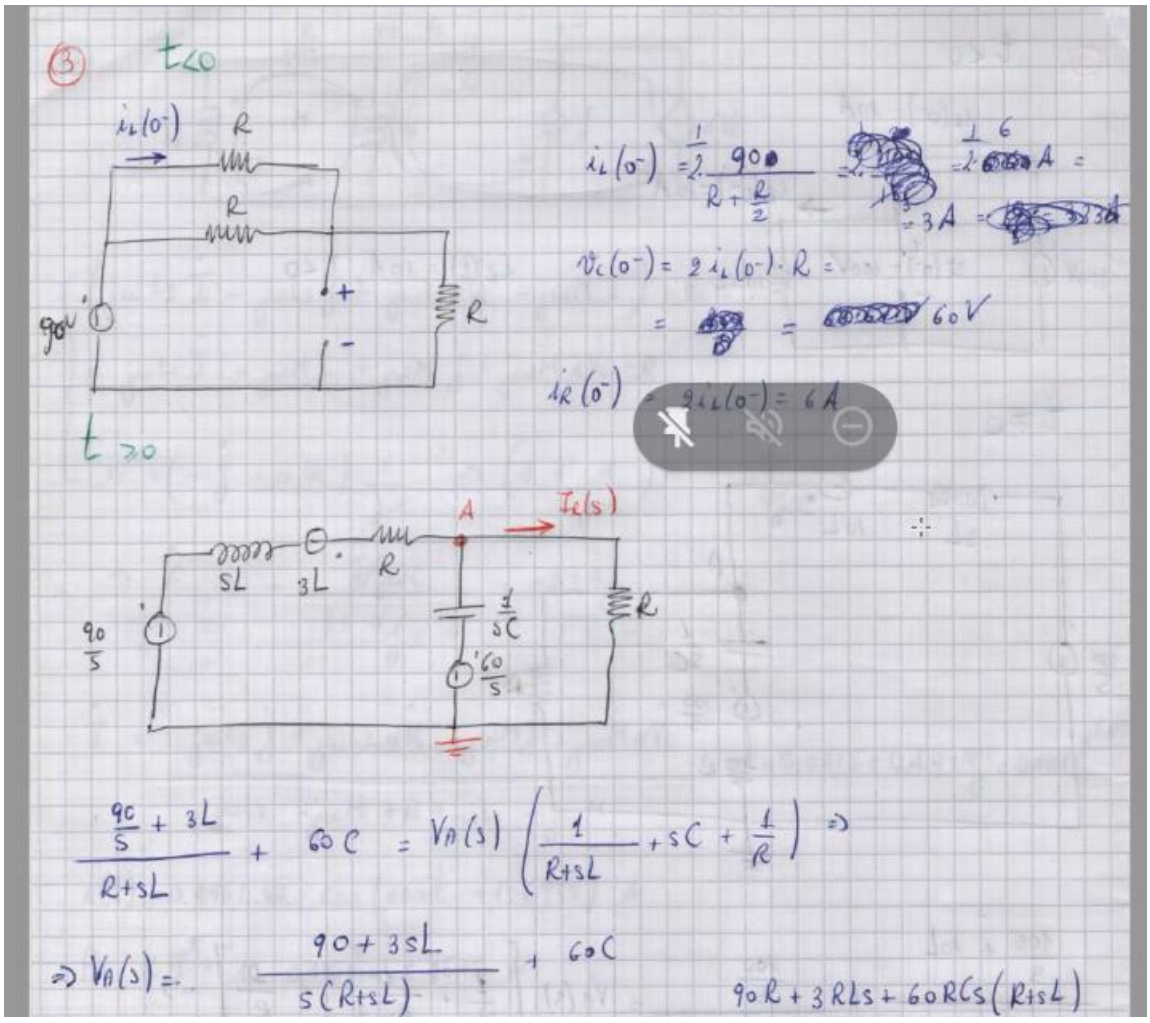

Appello Aprile 2022
① Calcolo RNO
IR
R
R
R
R
R
α IR
3R
α IR
IV
R/2
IP
VP
IP = IR + IJ
IR = (VP − α IR)/3R => 3R IR + α IR = VP => IR = VP/(3R+α) = VP/35
IJ = VP/(R/2) = VP/5 => IP = VP/35 + VP/5 = 8 VP/35 => RNO = 35/8 = 4.375 Ω
Calcolo INO
R
R
R
R
α IR
IR
2R
A
R
J
α IR
R/2
2

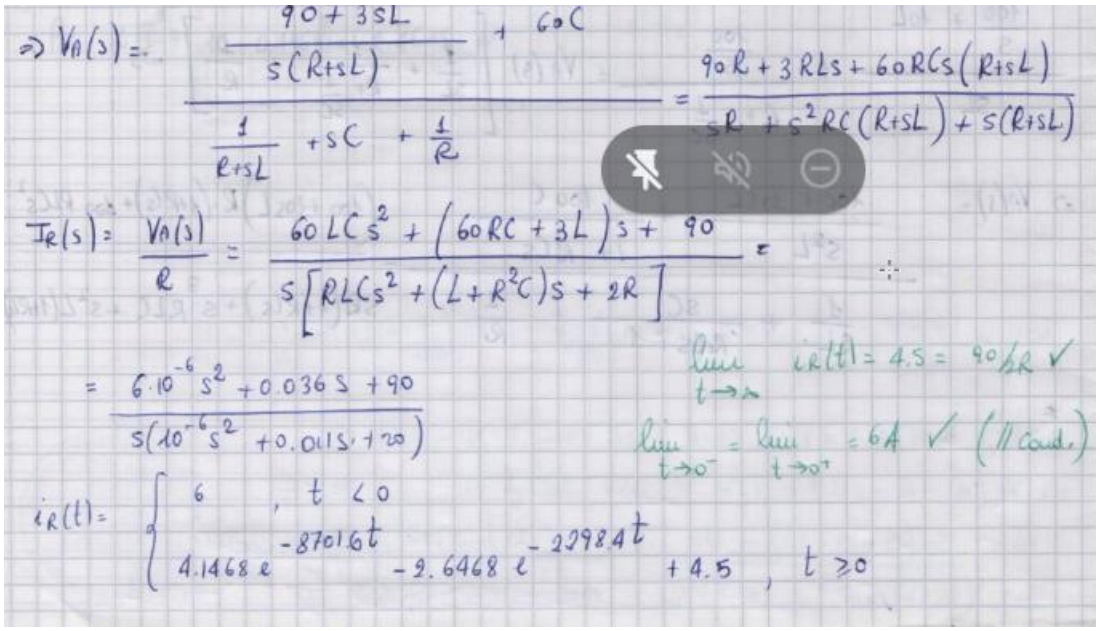

Calcolo INO
R
R
R
R
R
α IR
V
IR
2R
A
R
J
α IR
R/2
2
V
R
INO
IR = −(VA − V)/2R ;
A: J = α(VA − V)/2R² = VA(1/2R + 1/R) − V/2R − V/R
2R²J = α VA + α V = VA·R + 2R VA − V·R − 2RV =>
=> VA(α − R − 2R) = V(α − R − 2R) − 2R²J =>
=> VA = [50(5 − 10 − 20) − 100] / [50·(−35) − 100] = [illegible]
INO = (VA − V)/2R + (0 − V)/R/2 = [illegible] − 10 = −9.8571 A

ESERCIZIO 2


2
R
+ Vc −
C
L1
M
L2
I
J
αVc
(jωL2 İ − jωL2 J̇ − jωL2 α V̇c − jωM İ) + R İ
+ jωL1 İ − jωM İ + jωM J̇ + jωM α V̇c = 0
V̇c = (− J̇ − α V̇c) 1/jωC ⇒ (1 + α/jωC) Vc = − J/jωC
⇒ V̇c = − J/jωC / (1 + α/jωC) = −8 + 4j
İ = (jωL2 J̇ + jωL2 α V̇c − jωM J̇ − jωM α V̇c) / (jωL2 − jωM + R + jωL1 − jωM) = −0,0615 + 0.4923j = 0.4961 e^{j1.6}
i(t) = 0.4961 √2 · cos(1000t + 1.6952) A
P = R I² = 10 · 0.4961² = 2.4615 W

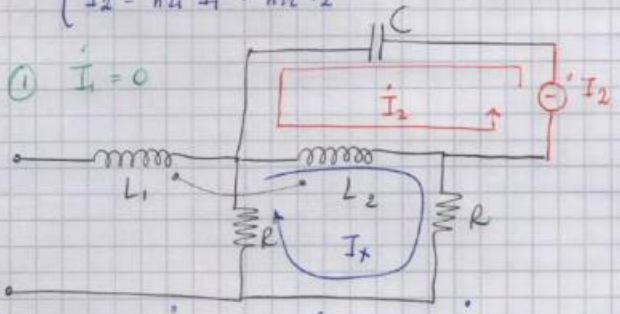
ESERCIZIO 3


③ t<0
$i_L(0^-)$
R
R
R
90V
+
-
$i_L(0^-) = \frac{1}{2}\cdot\frac{90}{R+\frac{R}{2}} = \frac{1}{2}\cdot 6\,A = 3A$
$v_C(0^-) = 2\,i_L(0^-)\cdot R = 60V$
$i_R(0^-) = 2\,i_L(0^-) = 6A$
t ≥ 0
A
$I_L(s)$
sL
3L
R
$\frac{1}{sC}$
R
$\frac{90}{s}$
$\frac{60}{s}$
$\frac{\frac{90}{s}+3sL}{R+sL} + 60C = V_A(s)\left(\frac{1}{R+sL}+sC+\frac{1}{R}\right) \Rightarrow$
$\Rightarrow V_A(s) = \frac{90+3sL}{s(R+sL)} + 60C$
$90R + 3RLs + 60RCs(R+sL)$


$\Rightarrow V_A(s) = \frac{\frac{90+3sL}{s(R+sL)} + 60C}{\frac{1}{R+sL}+sC+\frac{1}{R}} = \frac{90R+3RLs+60RCs(R+sL)}{sR+s^2RC(R+sL)+s(R+sL)}$
$I_R(s) = \frac{V_A(s)}{R} = \frac{60LCs^2+(60RC+3L)s+90}{s\left[RLCs^2+(L+R^2C)s+2R\right]} =$
$= \frac{6\cdot10^{-6}s^2+0.036s+90}{s(10^{-6}s^2+0.011s+20)}$
$\lim_{t\to\infty} i_R(t) = 4.5 = 90/2R$ ✓
$\lim_{t\to0^-} = \lim_{t\to0^+} = 6A$ ✓ (Il cond.)
$i_R(t) = \begin{cases} 6, & t<0 \\ 4.1468\,e^{-8701.6t} - 2.6468\,e^{-2298.4t} + 4.5, & t\geq0 \end{cases}$

ESERCIZIO 4

④ $\begin{cases} \dot{V}_1 = \bar{h}_{11}\dot{I}_1 + \bar{h}_{12}\dot{V}_2 \\ \dot{I}_2 = \bar{h}_{21}\dot{I}_1 + \bar{h}_{22}\dot{V}_2 \end{cases}$ $\quad h = \begin{bmatrix} 5.625 + 8.125j & 0.25+0.25j \\ -0.25-0.25j & 0.1 \end{bmatrix}$

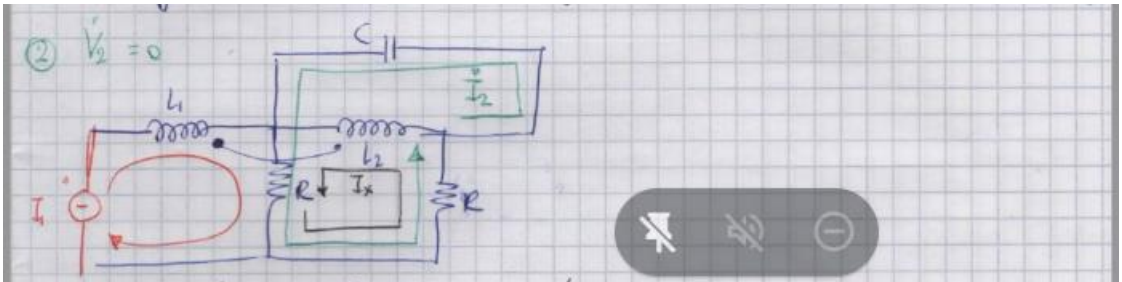


① $\dot{I}_1 = 0$

$(2R + j\omega L_2)\dot{I}_x + j\omega L_2 \dot{I}_2 = 0 \Rightarrow \dot{I}_x = -\dfrac{j\omega L_2 \dot{I}_2}{2R + j\omega L_2} = (-0.5 - 0.5j)\dot{I}_2 = \gamma \dot{I}_2$

$\dot{V}_2 = \dfrac{1}{j\omega C}\dot{I}_2 - 2R\gamma\dot{I}_2 \Rightarrow \bar{h}_{22} = \left(\dfrac{1}{j\omega C} - 2\gamma R\right)^{-1} = 0.1$

$\dot{V}_1 = -j\omega M(\dot{I}_2 + \gamma\dot{I}_2) - \gamma R\dot{I}_2 = (-j\omega M - j\omega M\gamma - \gamma R)\bar{h}_{22}\dot{V}_2 \Rightarrow \bar{h}_{12} = 0.25+0.25j$



② $\dot{V}_2 = 0$

$\begin{cases} (2R + j\omega L_2)\dot{I}_x + 2R\dot{I}_2 + (R + j\omega M)\dot{I}_1 = 0 \\ \left(\dfrac{1}{j\omega C} + 2R\right)\dot{I}_2 + R\dot{I}_1 + 2R\dot{I}_x = 0 \Rightarrow \dot{I}_x = -\dfrac{1}{2}\dot{I}_1 - \dfrac{\frac{1}{j\omega C} + 2R}{2R}\dot{I}_2 = \underbrace{(-0.125+0.125j)}_{=\bar{\gamma}_2}\dot{I}_1 \end{cases}$

$(2R+j\omega L_2)\left(-\dfrac{1}{2}\dot{I}_1\right) + (2R+j\omega L_1)\left(-\dfrac{\frac{1}{j\omega C}+2R}{2R}\right)\dot{I}_2 + 2R\dot{I}_2 + (R+j\omega M)\dot{I}_1 = 0$

$\dot{I}_2 = \dfrac{(2R+j\omega L_2)\left(\frac{1}{2}\right) - (R+j\omega M)}{(2R+j\omega L_2)\left(-\frac{\frac{1}{j\omega C}+2R}{2R}\right) + 2R}\dot{I}_1 = (-0.25-0.25j)\dot{I}_1 = \gamma\dot{I}_1 - \bar{h}_{21}\dot{I}_1$

$\dot{V}_1 = j\omega L_1\dot{I}_1 + j\omega M\dot{I}_x + R(\dot{I}_1 + \dot{I}_2 + \dot{I}_x) =$

$= j\omega L_1 + j\omega M\bar{\gamma}_2 + R + R\bar{\gamma} + R\bar{\gamma}_2 = 5.625 + 8.125j$