EE 221 Circuits II

Lecture 10

Feb. 27, 2019

$Z_L = j \cdot 2\pi \cdot 60 \cdot 0.1$

$Z_L = j37.68$

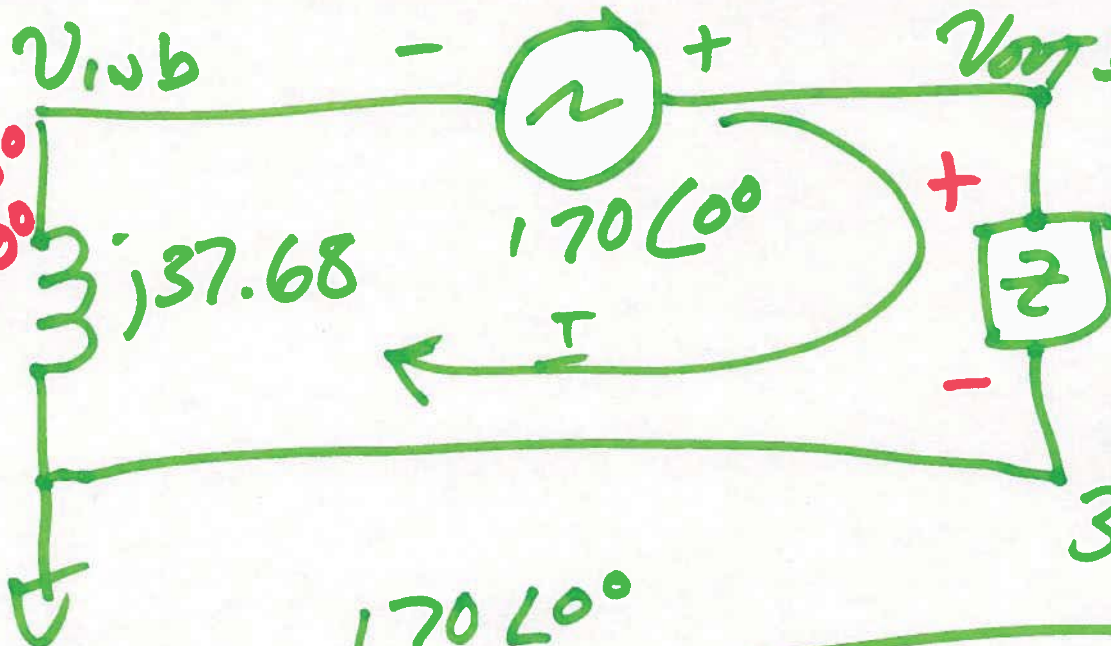
$Z_C = \dfrac{1}{j \cdot 2\pi \cdot C \cdot f} = j(-132.7)$

I, II, III, IV

$$\frac{53{,}080\angle -90^\circ}{421\angle -18.35} = Z = \frac{400\angle 0^\circ \cdot 132.7\angle -90}{400 + j(-132.7)}$$

$400 + j(-132.7) \rightarrow 421\angle -18.35^\circ$

$Z = 126\angle -71.65$



-118.7

$-1.86\angle 64.3^\circ$
$-37.68\angle 90^\circ$

$V_{out\,b} = 1.86\angle 64.3^\circ$

$\times\, 126 \angle -71.65$

$234.36 \angle -7.35^\circ$

$126\angle -71.65$

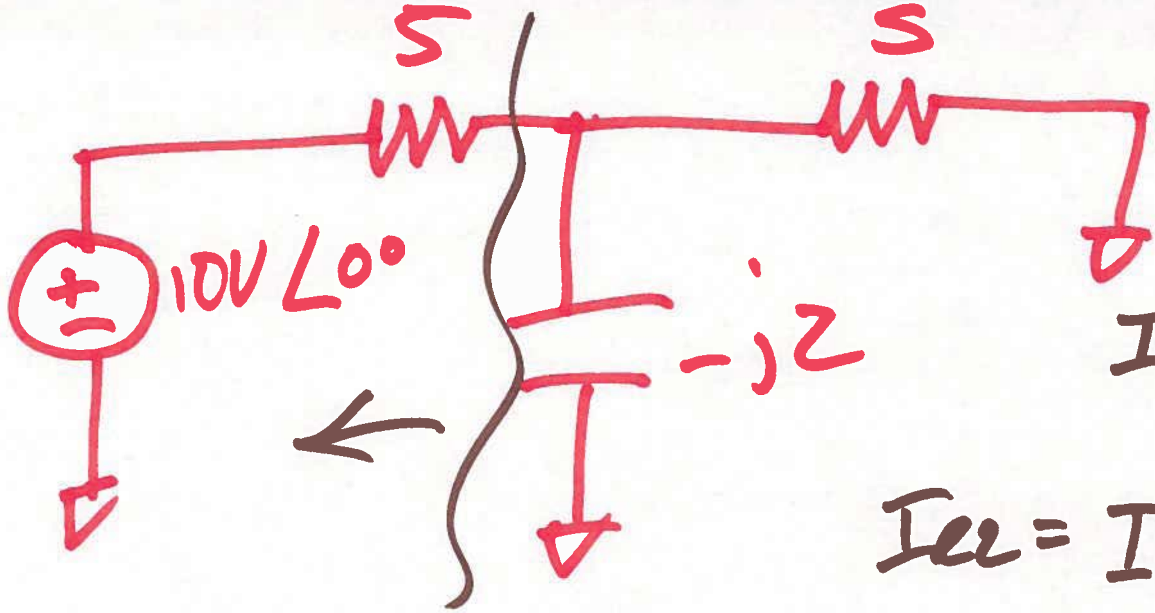
$39.7 + j(-120)$

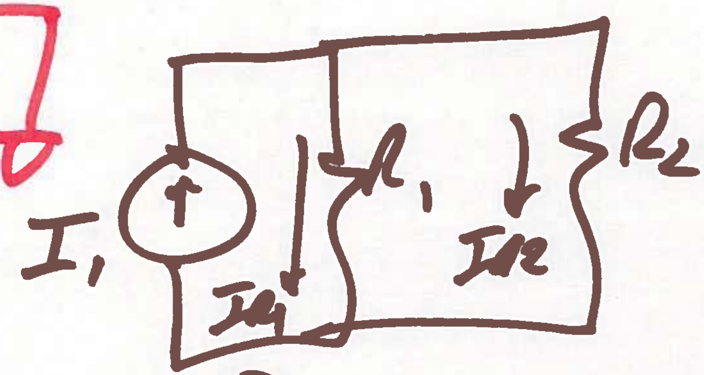
$$\vec{I} = \frac{170\angle 0^\circ}{j37.68 + 39.7 + j(-120)}$$

$$= \frac{170\angle 0^\circ}{39.7 + j(-82.32)} = \frac{170\angle 0^\circ}{91.4\angle -64.3^\circ}$$

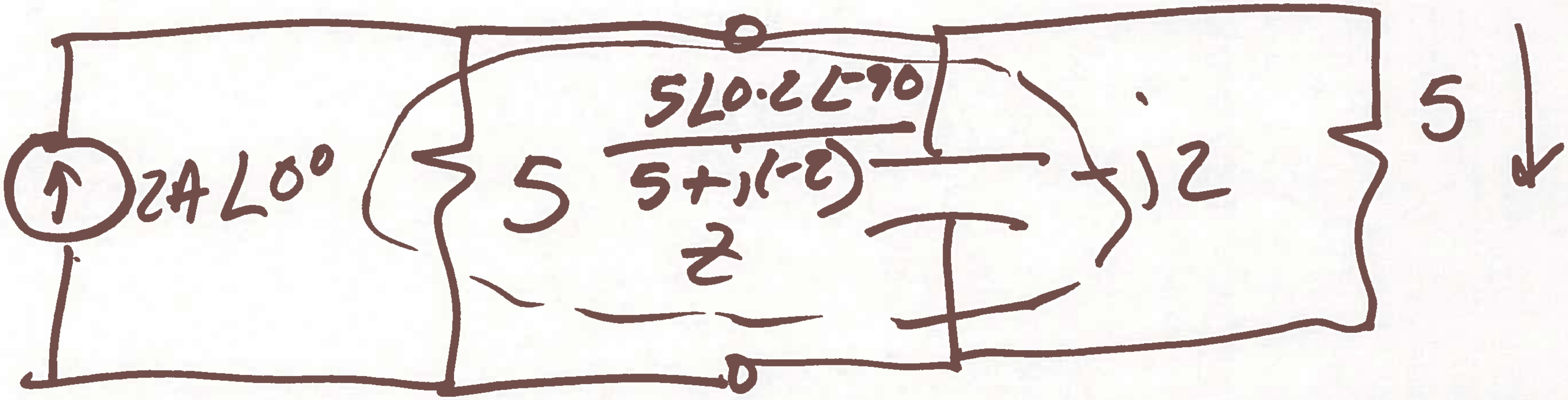
$$\boxed{\vec{I} = 1.86\angle 64.3^\circ}$$

2)

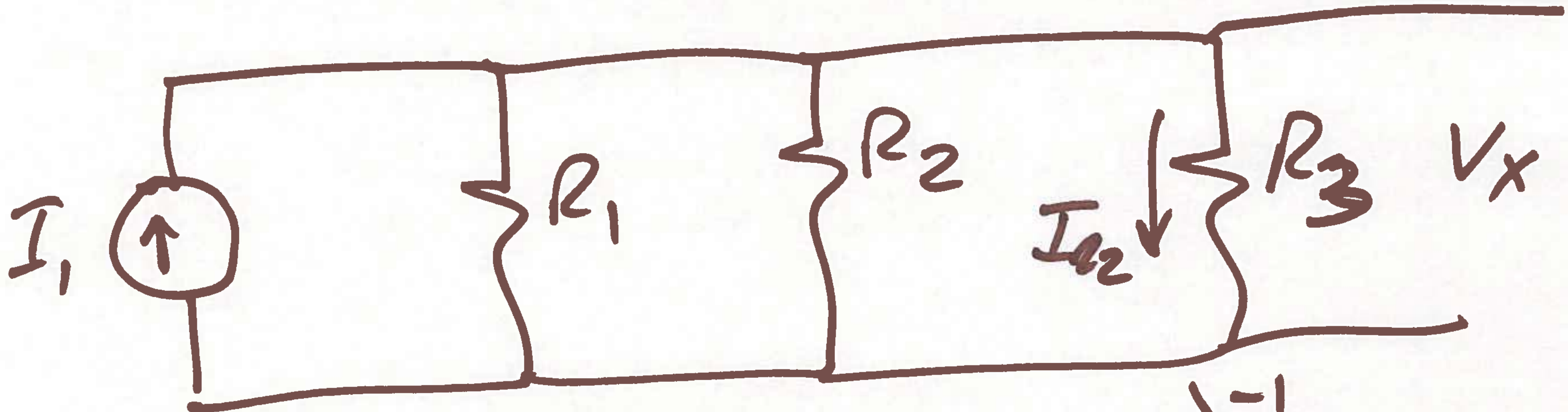




$$I_{R2} = I_1 \cdot \frac{R_1}{R_1+R_2}$$



$$I = 2A\angle 0^\circ \cdot \frac{Z}{Z+5}$$

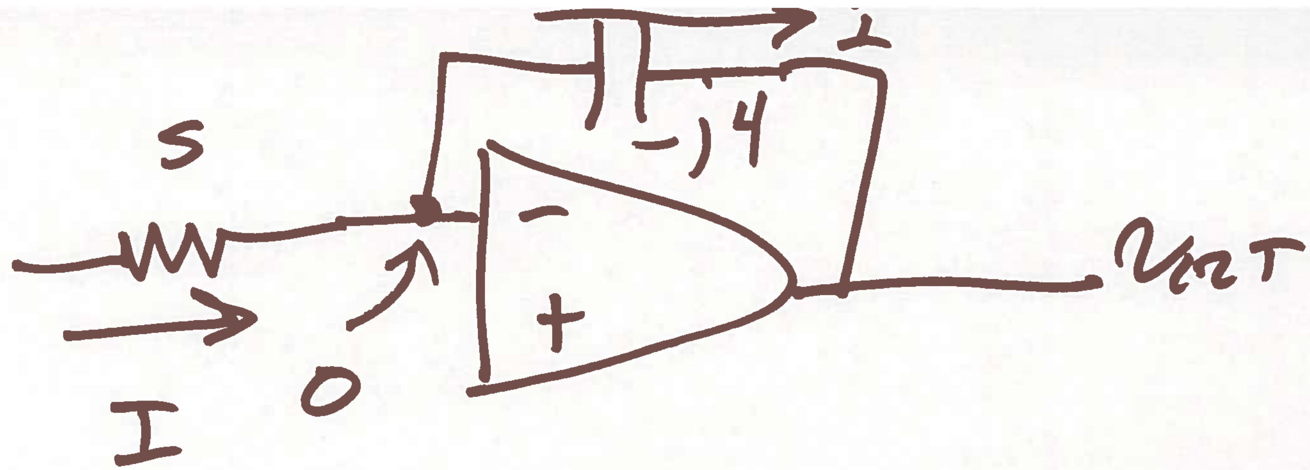


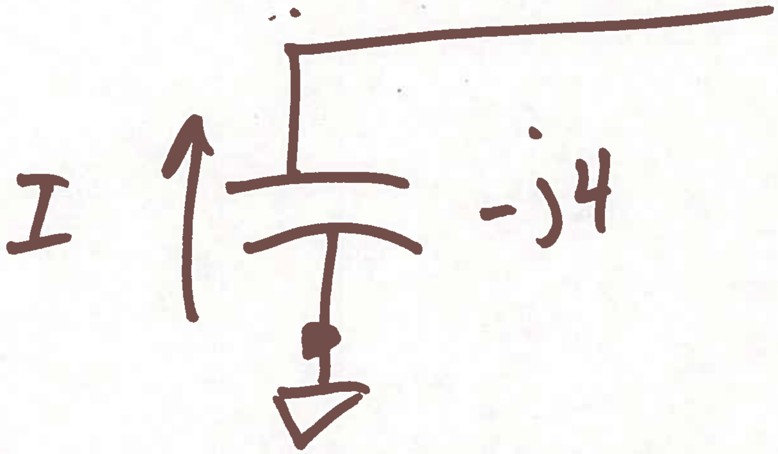
$$V_x = I_1\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)^{-1}$$

$$I_1 = \frac{V_x}{R_1} + \frac{V_x}{R_2} + \underbrace{\frac{V_x}{R_3}}_{I_{R2}}$$

$$I_{R2} = \frac{R_1 + R_2}{R_1 + R_2 + R_3} \cdot I_1 \, ?$$

NO!





$$v_{OUT} = -I\cdot(-j4)$$

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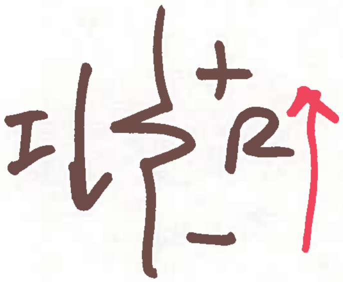
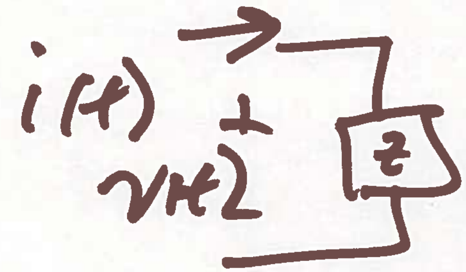
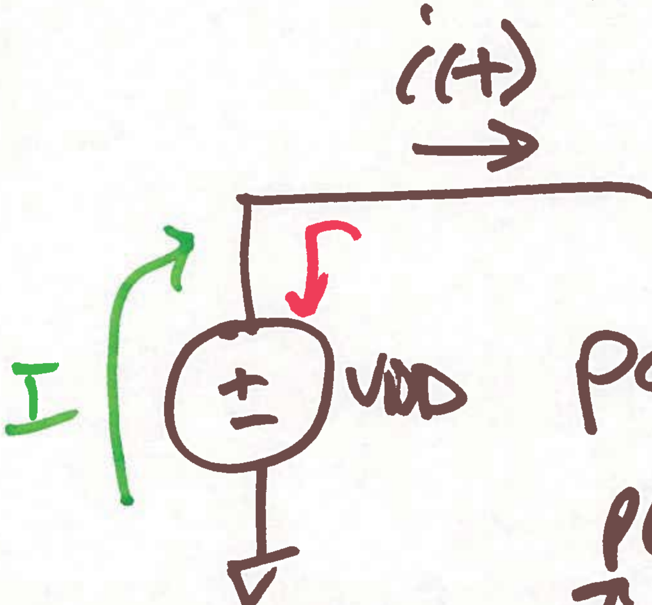
Average (periodic)

$$X_{AVG} = \frac{1}{T}\int_0^T x(t)\cdot dt$$





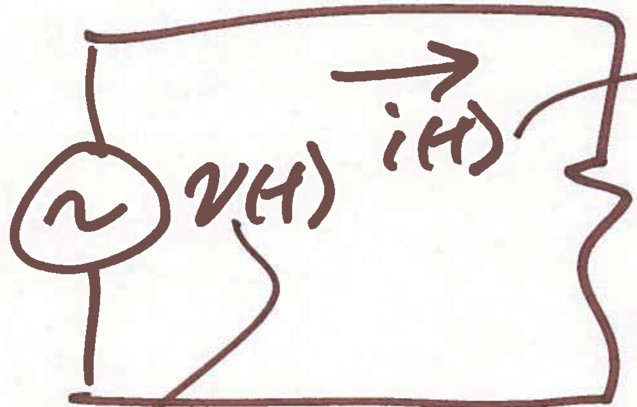


power supplied

$$p(t) = v(t)\cdot i(t)$$

$$= VDD\cdot i(t)$$

instantaneous power



$$I_{rms} = \frac{I_m}{\sqrt{2}}$$

$$\boxed{P_{AVG} = I_{rms} \cdot V_{rms}}$$

TRUE ONLY when RESISTIVE

$$V_m \cos(\omega t + \phi_V)$$

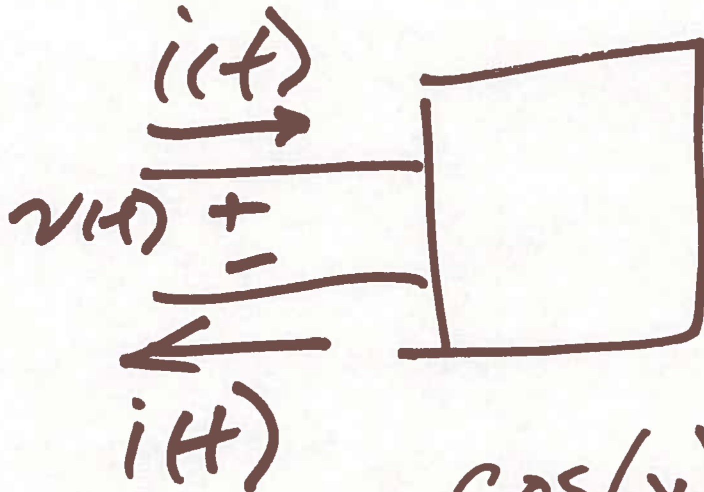
magnitude VP

$$RMS = \sqrt{\frac{1}{T}\int_0^T v^2(t)\, dt}$$

$$V_{rms} = \frac{V_m}{\sqrt{2}}$$

$$v(t) = V_m \cos(\omega t + \phi_v)$$

$$i(t) = I_m \cos(\omega t + \phi_i)$$



$$p(t) = v(t) \cdot i(t)$$

$$= V_m I_m \cos(\omega t + \phi_v) \cdot \cos(\omega t + \phi_I)$$

$$\cos(x) \cdot \cos y = \frac{1}{2}\cos(x-y) + \frac{1}{2}\cos(x+y)$$

instantaneous power

$$p(t) = \frac{1}{T}\int_0^T \frac{V_m I_m}{2}\cos(\phi_v - \phi_I) + \frac{1}{T}\int_0^T \cos(2\omega t + \phi_v + \phi_I)$$

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$$P_{AVG} = \frac{1}{T}\cdot\int_0^T p(t)\cdot dt, \quad \int_0^T dT = T - 0$$

$a+jb \to a-jb$

$Ae^{j\theta} \to Ae^{-j\theta}$

$$P_{AVG} = \frac{1}{\cancel{T}}\cdot(\cancel{T}-0)\cdot\frac{V_m I_m}{2}\cos(\phi_V - \phi_I)$$

$$P_{AVG} = \frac{V_m I_m}{2}\cos(\phi_V - \phi_I)$$

resistive load!

$$= \frac{V_m}{\sqrt{2}}\cdot\frac{I_m}{\sqrt{2}} = I_{rms} V_{rms}$$

most not resistive

$$P_{AVG} = \frac{V_m I_m}{2}\cdot\underbrace{\cos(\phi_V - \phi_I)}_{\text{power factor}}$$