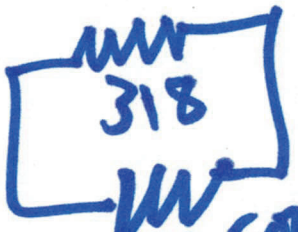
EE 220 Circuits I

Lecture 24

November 27, 2023

$$\frac{1}{j \cdot 2\pi \cdot 500 \cdot .1\,\mu F} = -j318.5\,\Omega$$



$$\frac{250k \cdot 318}{250k + 318} \qquad \frac{318}{1 + \frac{318}{250k}} \qquad 1.0017 \quad 2.5\angle 0$$

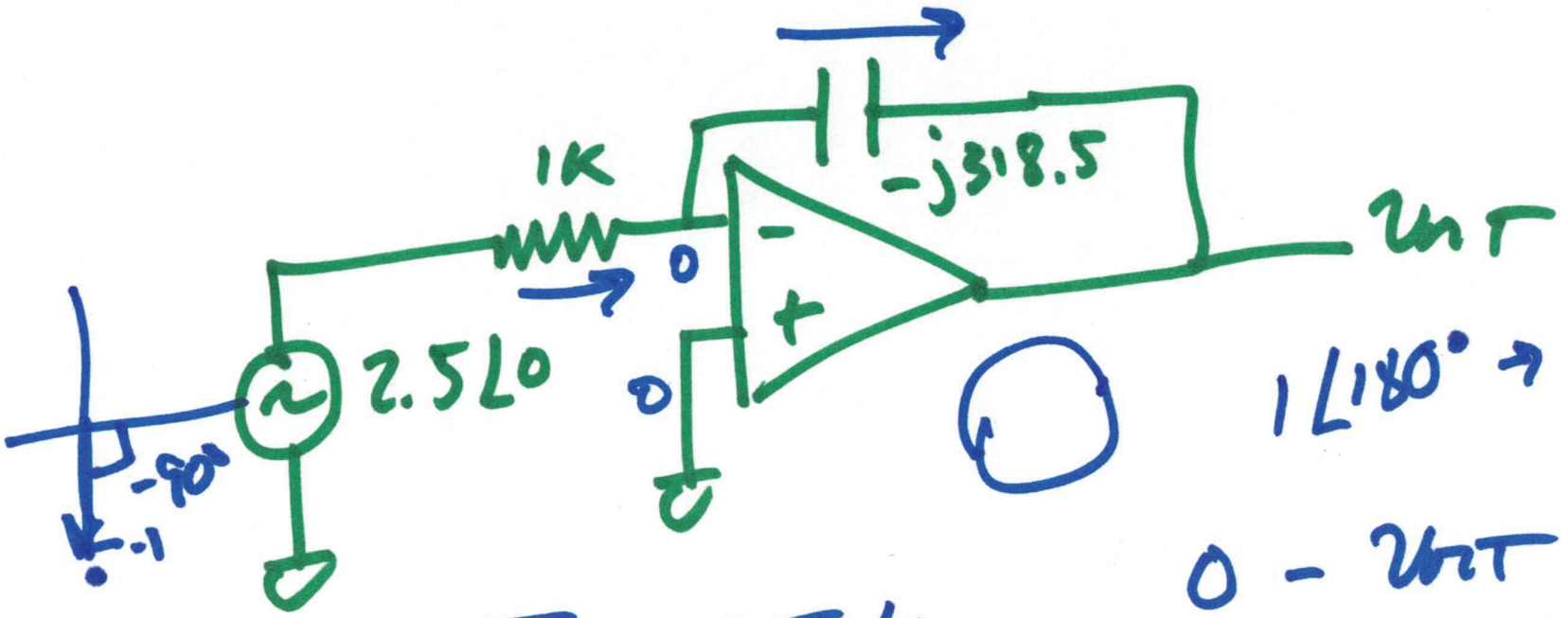
$2.5\angle 0$

$2.5 + j0$

$2.5 \sin(2\pi \cdot 500t)$

$$12.5 + j0 \,|\, = \sqrt{2.5^2 + 0^2} = 2.5$$

$$\angle 2.5 + j0 \rightarrow \tan^{-1}\frac{0}{2.5} = 0$$



$1\angle 180° \rightarrow 1\angle -180°$

$|-j318.5| = \sqrt{39.5^2 \times 10^2}$

$\frac{2.5\angle 0}{1K} = \frac{0 - V_{out}}{-j318.5}$

$\tan^{-1} \frac{-j}{0}$

$\tan^{-1} -\infty$

$-\tan^{-1}\infty$

$-90-(-180) = 90$

$-90-180 = -270$

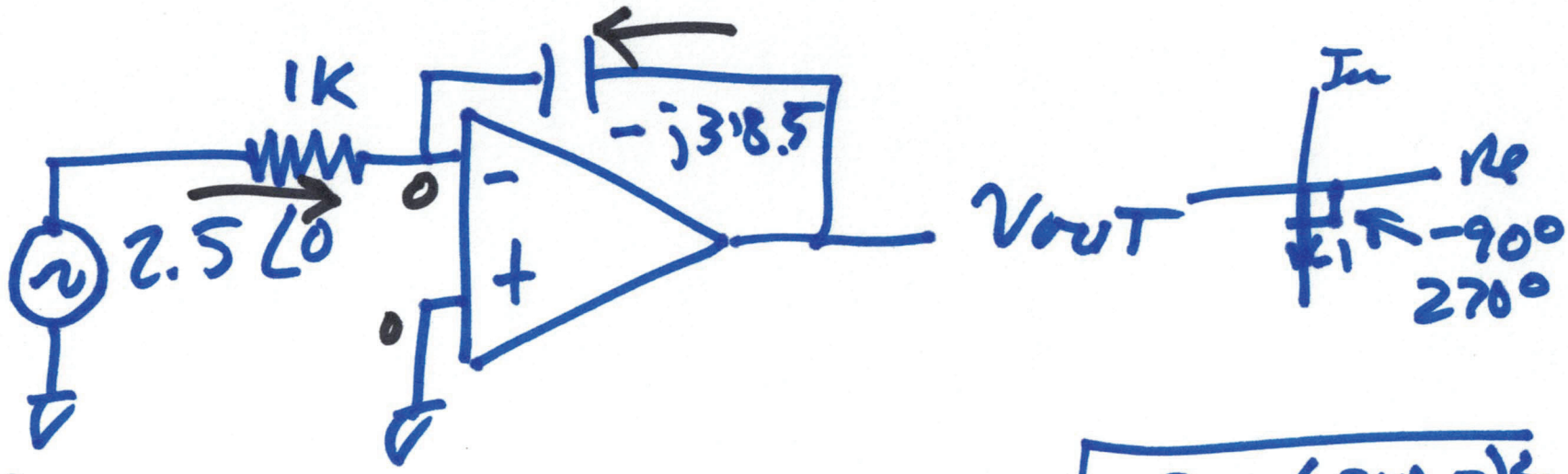
$-V_{out} = V_{out}\angle 180 = (2.5mA\angle 0°) \cdot (318\angle -90)$

$V_{out}\angle 180° = .795\angle -90°$

$V_{out}\angle 0° \cdot 1\angle 180°$

$V_{out} = \frac{.795\angle -90}{1\angle \pm 180°} = .795\angle 90$

2)



$\tan^{-1}(-x) = -\tan^{-1}(x)$ odd function

$|0 + j(-318.5)| = \sqrt{0^2 + (-318.5)^2}$

$= 318.5$

$\angle 0 + j(-318.5) = \tan^{-1}\frac{-318.5}{0}$

$= -\tan^{-1}\infty$

$\angle -90°$

$$\frac{2.5\text{mA}\angle 0}{1\text{k}} + \frac{V_{out} - 0}{-j318.5} = 0$$

$$\frac{a}{-b} = -\frac{a}{b} = \frac{-a}{b}$$

$$2.5\text{mA}\angle 0 = \frac{V_{out}}{j318.5}$$

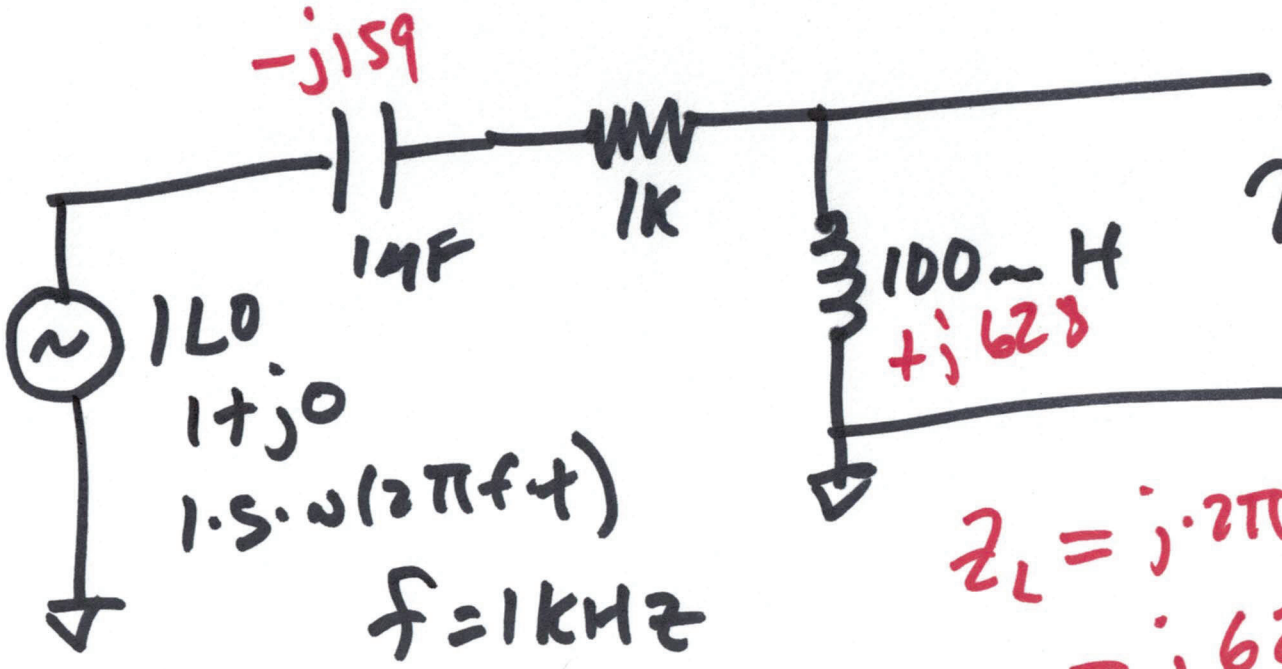
$$2.5\text{mA}\angle 0 = \frac{V_{out}}{318.5\angle 90}$$

$$V_{out} = 2.5\text{mA}\angle 0 \cdot 318.5\angle 90$$

$$V_{out} = 0.795\angle 90^\circ$$

$$\frac{t_d}{T} \cdot 360 = 90$$

$$t_d = T \cdot \frac{1}{4}$$



$v_{nT} = ?$

$Z_L = j \cdot 2\pi \cdot 10^3 \cdot 10^{-1}$

$= j628\,\Omega$

$$v_{nT} = 1\angle 0 \cdot \frac{j628}{j628 + 10^3 + j(-159)}$$

$$= \frac{628\angle 90}{1000 + j469} = \frac{628\angle 90}{1105\angle 25}$$

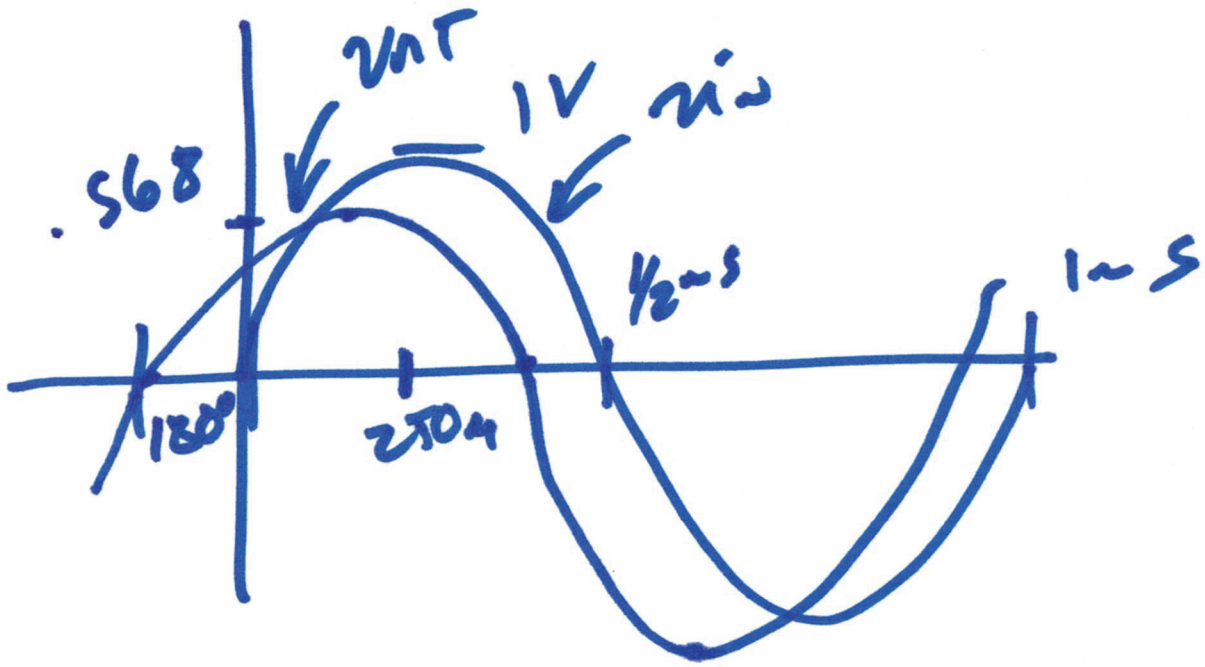
$v_{nT} = 568\text{m}V\angle 65°$

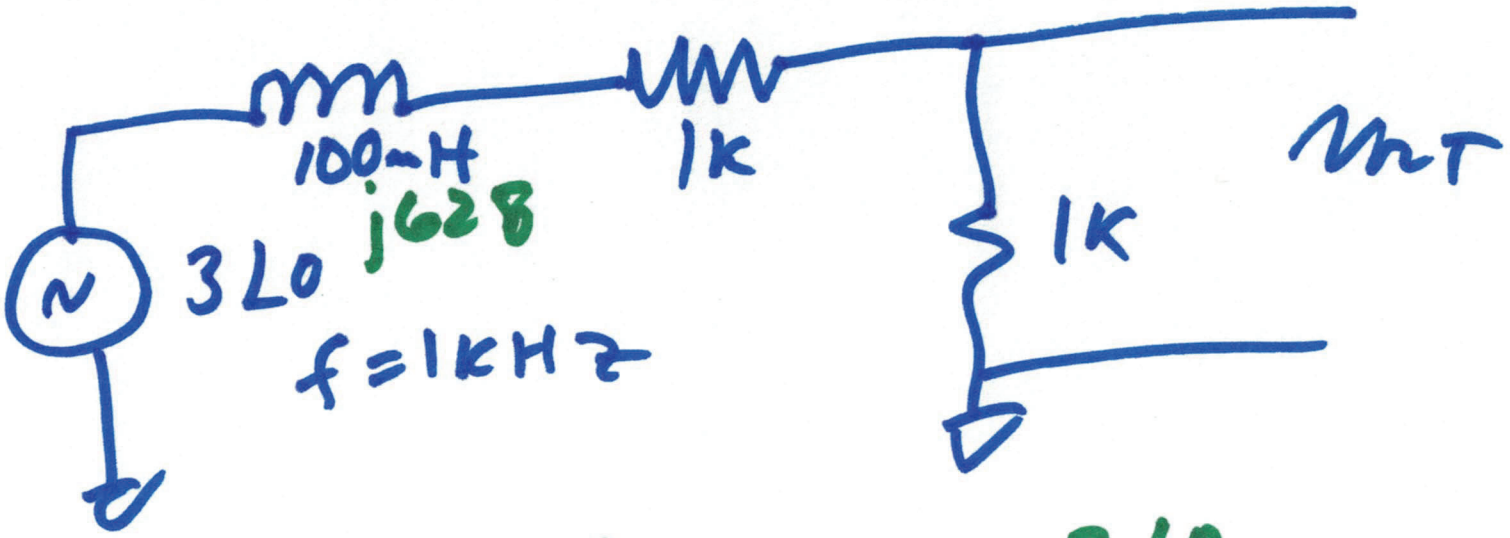
$v_{nT}(t) = 568\text{m}V \sin(2\pi \cdot 10^3 \cdot t + 65)$

5)

$$\frac{t_d}{1\,ms} \cdot 360 = 65$$

$$t_d = 180\,\mu s$$





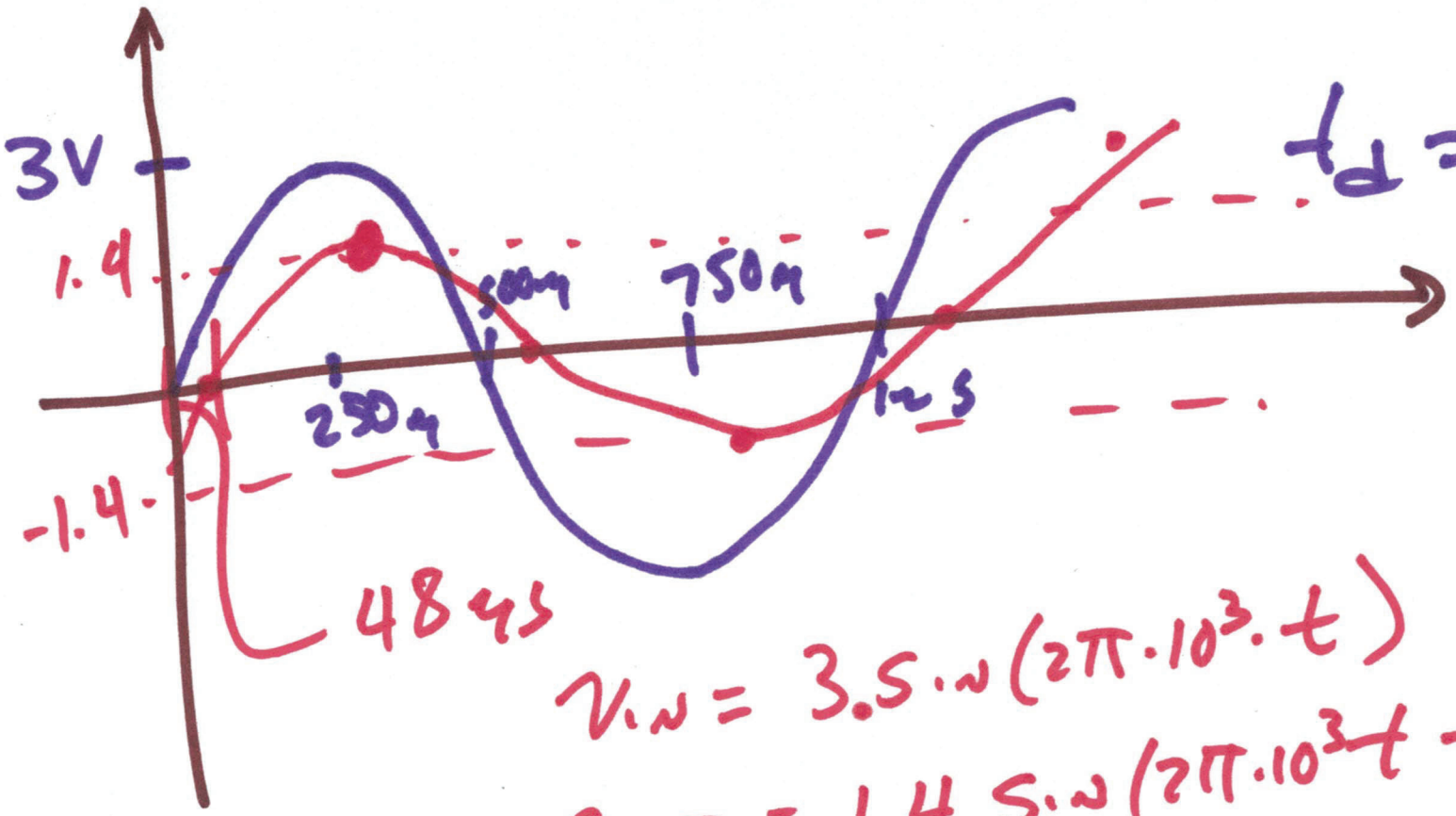
$$V_{out} = \frac{10^3}{10^3 + 10^3 + j628} \cdot 3\angle 0$$

$$= \frac{3\angle 0}{2 + j.628} = \frac{3\angle 0}{2.1\angle 17.4^\circ}$$

$$= 1.43\angle -17.4^\circ$$

$$\frac{t_d}{1ms} \cdot 360 = 17.4$$

$$t_d = 48.4s$$



$$v_{in} = 3.5 \cdot \sin(2\pi \cdot 10^3 \cdot t)$$

$$v_{out} = 1.4\,5 \cdot \sin(2\pi \cdot 10^3 t - 17.4)$$