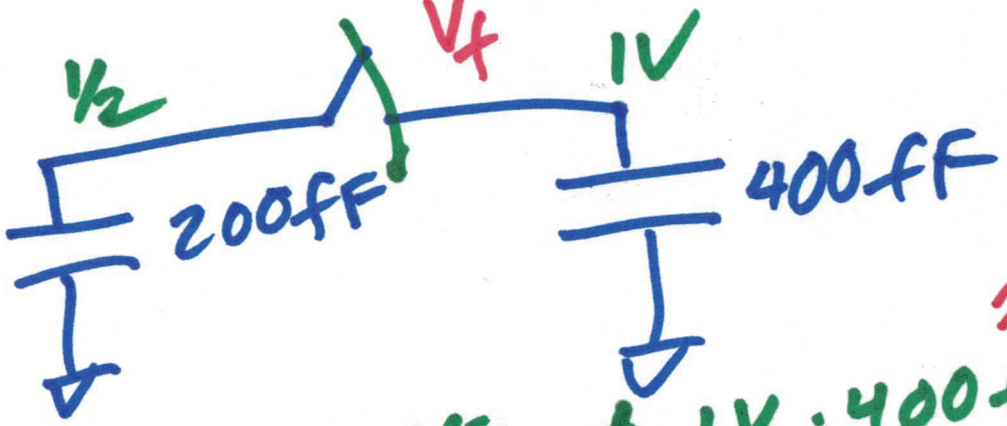
EE 220 Circuits I

Lecture 22

Nov. 20, 2023

$CV = Q$



$\frac{1}{2} \cdot 200ff + 1V \cdot 400ff = 500fc$

$Q_{TOT,\,before}$

$= V_f \cdot 200ff + 400ff \cdot V_f = 600ff \cdot V_f$

$Q_{TOT,\,after}$

$V_f = \frac{500fc}{600fF}$

$V_f = \frac{5}{6} V$

Impedance = Resistance + j Susceptance

$$Z = R + jX$$

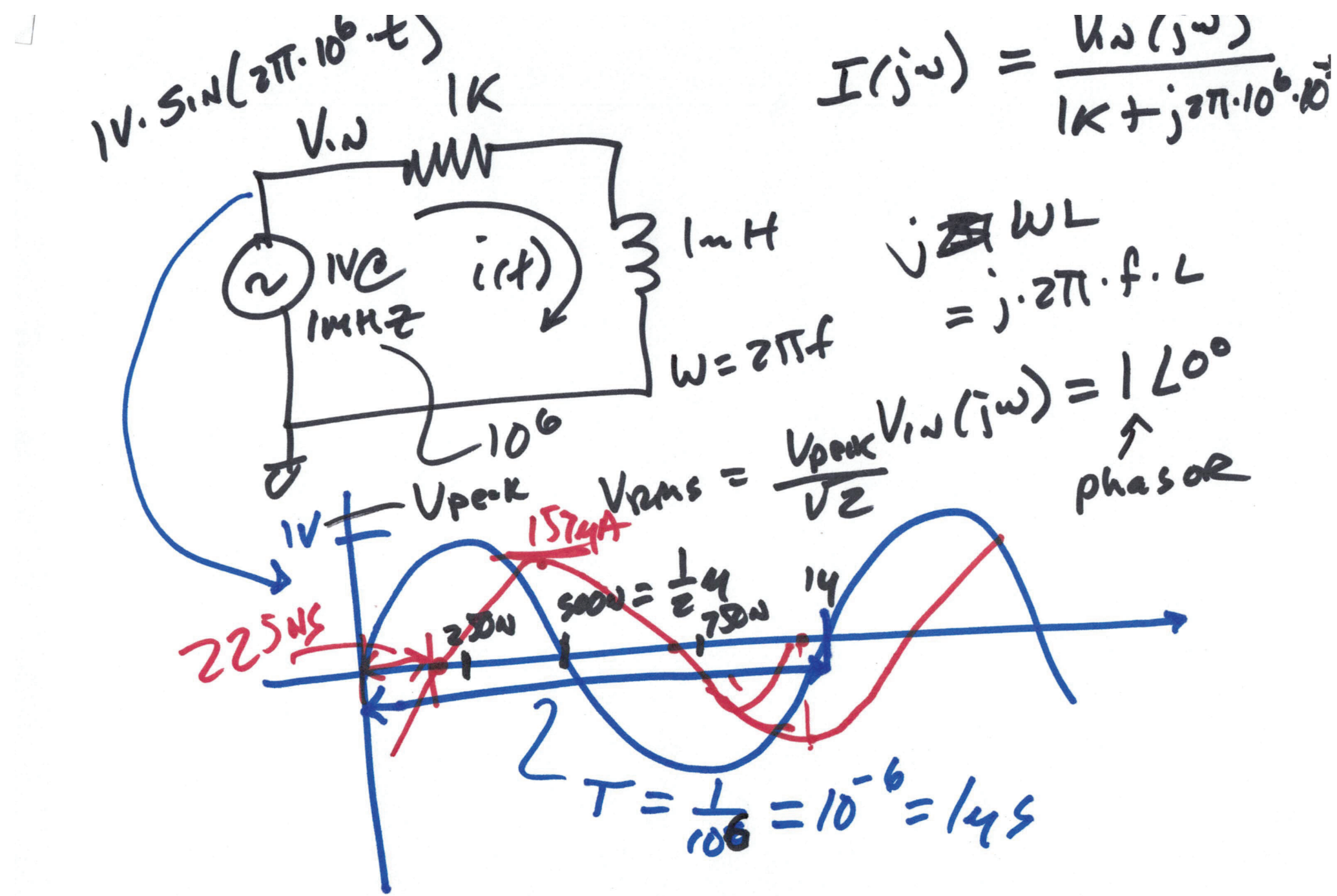
$$X = \frac{1}{\omega C} \qquad Z_{x,c} = \frac{1}{j\omega C}$$

X = neg. → cap

$$\text{Conductance} = \frac{1}{R}$$

$$Z_{x,L} = j\omega L$$

↑ ℧ MOS
mHOS

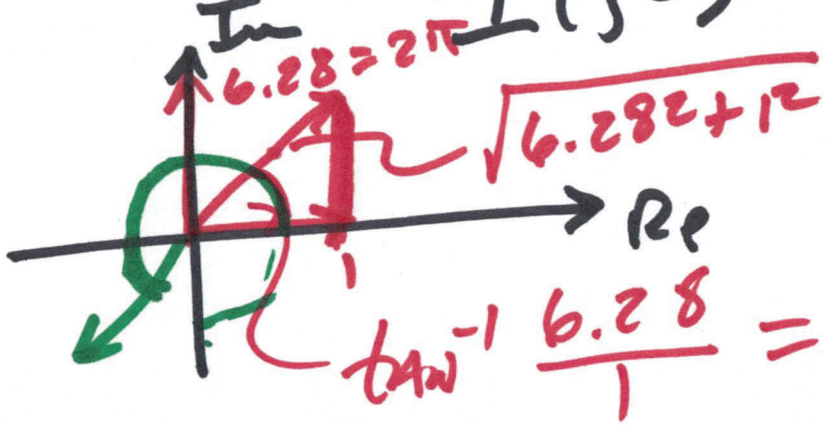

1V·SIN(2π·10^6·t)
1K
V_IN
1mH
1VPK
1MHz
i(t)
W=2πf
10^6
V_PEAK
V_RMS = V_PEAK/√2
I(jω) = V_IN(jω) / (1K + j2π·10^6·10^-3)
jωL
= j·2π·f·L
V_IN(jω) = 1∠0°
phasor
1V
157μA
225NS
250NS
500NS = 1/2 μ
750NS
1μ
2
T = 1/10^6 = 10^-6 = 1μS

$$I(j\omega) = \frac{1\angle 0^\circ}{10^3 + j2\pi 10^6 \cdot 10^{-3}}$$

$$\frac{1\angle 0^\circ}{10^3(1 + j2\pi)} = 1mA\angle 0 \cdot \frac{1}{1 + j\frac{2\pi}{6.28}}$$

$\frac{1}{10^3}$

$$I(j\omega) = 1mA\angle 0^\circ \cdot \frac{1\angle 0^\circ}{6.36\angle 81^\circ}$$

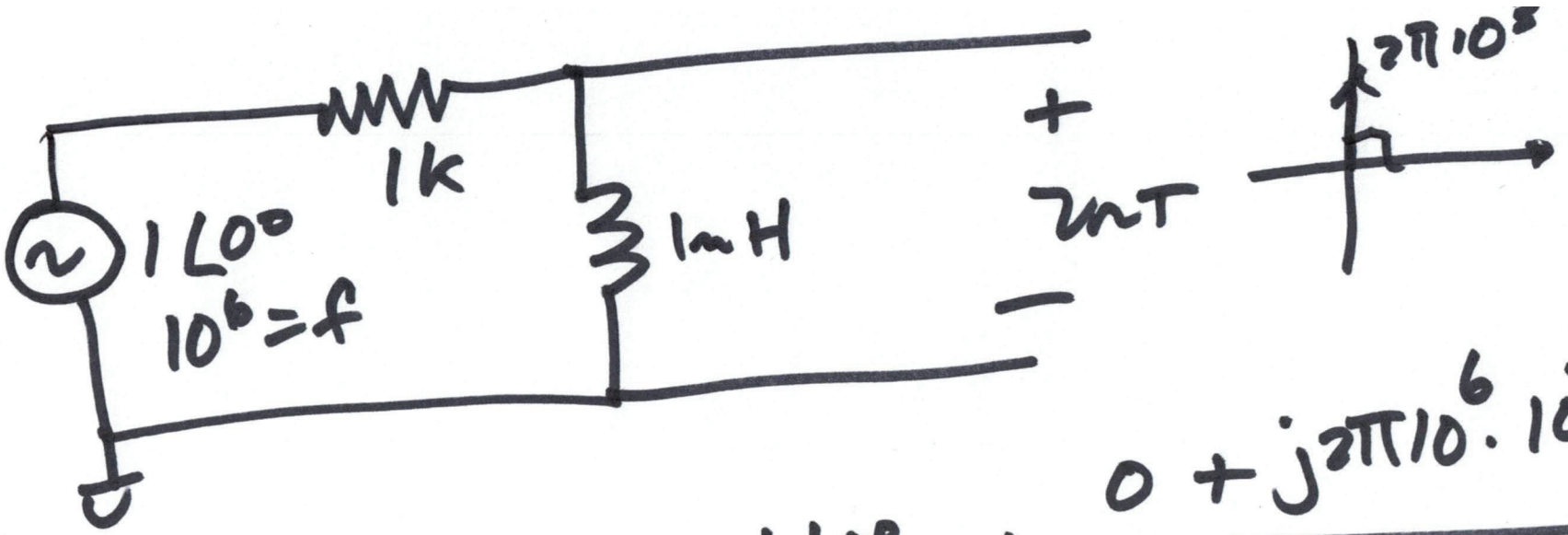


$$I(j\omega) = 157.4\,\mu A\angle -81^\circ$$

$$i(t) = 157.4\,\mu A \sin(2\pi \cdot 10^6 \cdot t - 81)$$

$$81 = 360 \cdot \frac{t_d}{1/4}$$

$$\boxed{t_d = 225\,ns}$$



$$V_{OUT} = 1\angle 0^\circ \cdot \frac{0 + j2\pi 10^6 \cdot 10^{-3}}{10^3 + j2\pi 10^6 \cdot 10^{-3}}$$

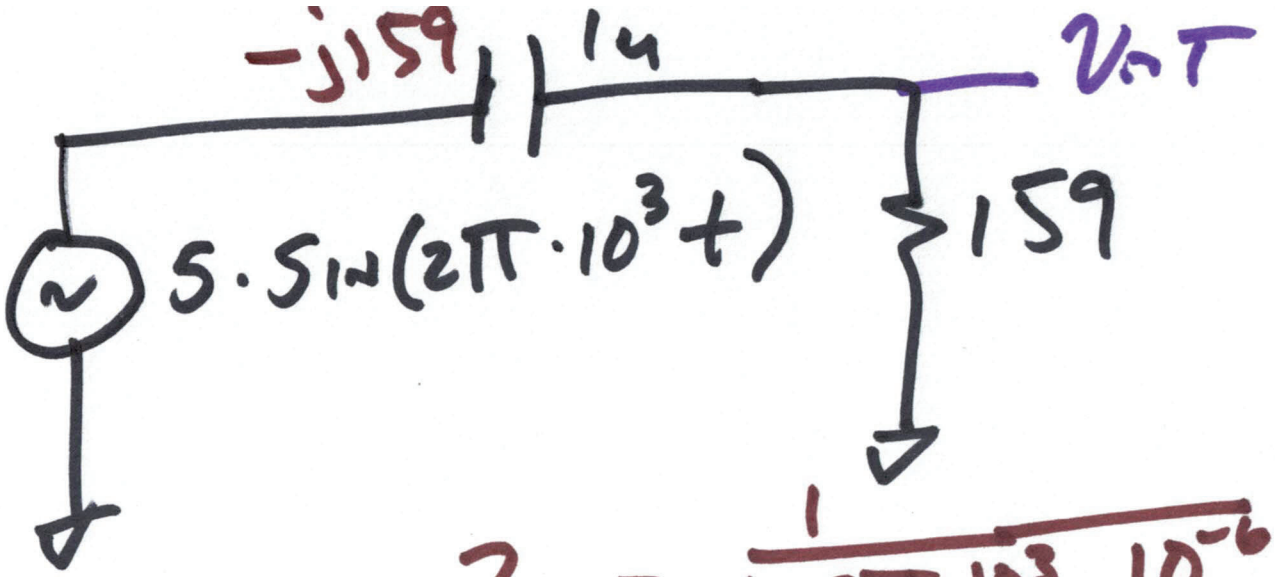
$$= \frac{1\angle 0^\circ \cdot 2\pi 10^3 \angle 90^\circ}{10^3(1 + j2\pi)}$$

$$v_{OUT} = .989 \sin(2\pi 10^6 t - 9)$$

$$.989\angle -9^\circ = \frac{2\pi \cancel{10^3}\angle 90^\circ}{\cancel{10^3}\ 6.36\angle 81^\circ}$$

$$-9 = 360 \cdot \frac{t_d}{1\mu} \qquad t_d = 25ns$$

5)



$j\omega L$

$$Z_C = \frac{1}{j \cdot 2\pi \cdot 10^3 \cdot 10^{-6}} = -j159$$

$$= \frac{1}{j2\pi f C} = \frac{1}{j\omega C}$$

$$v_{oT} = 5\angle 0 \cdot \frac{159}{159 - j159}$$

$$= \frac{5\angle 0^\circ}{1 - j} = \frac{5}{\sqrt{2}\angle -45^\circ}$$

$$V_{OUT} = \frac{5\ \angle 0}{\sqrt{2}\ \angle -45^\circ} = 3.54\ \angle 45^\circ$$

$0-(-45)$

$$\frac{t_d}{10^{-3}} \cdot 360 = 45^\circ$$

$$t_d = 125\,\mu s$$

$$v_{OUT}(t) = 3.54 \cdot \sin(2\pi \cdot 10^3 + 45^\circ)$$