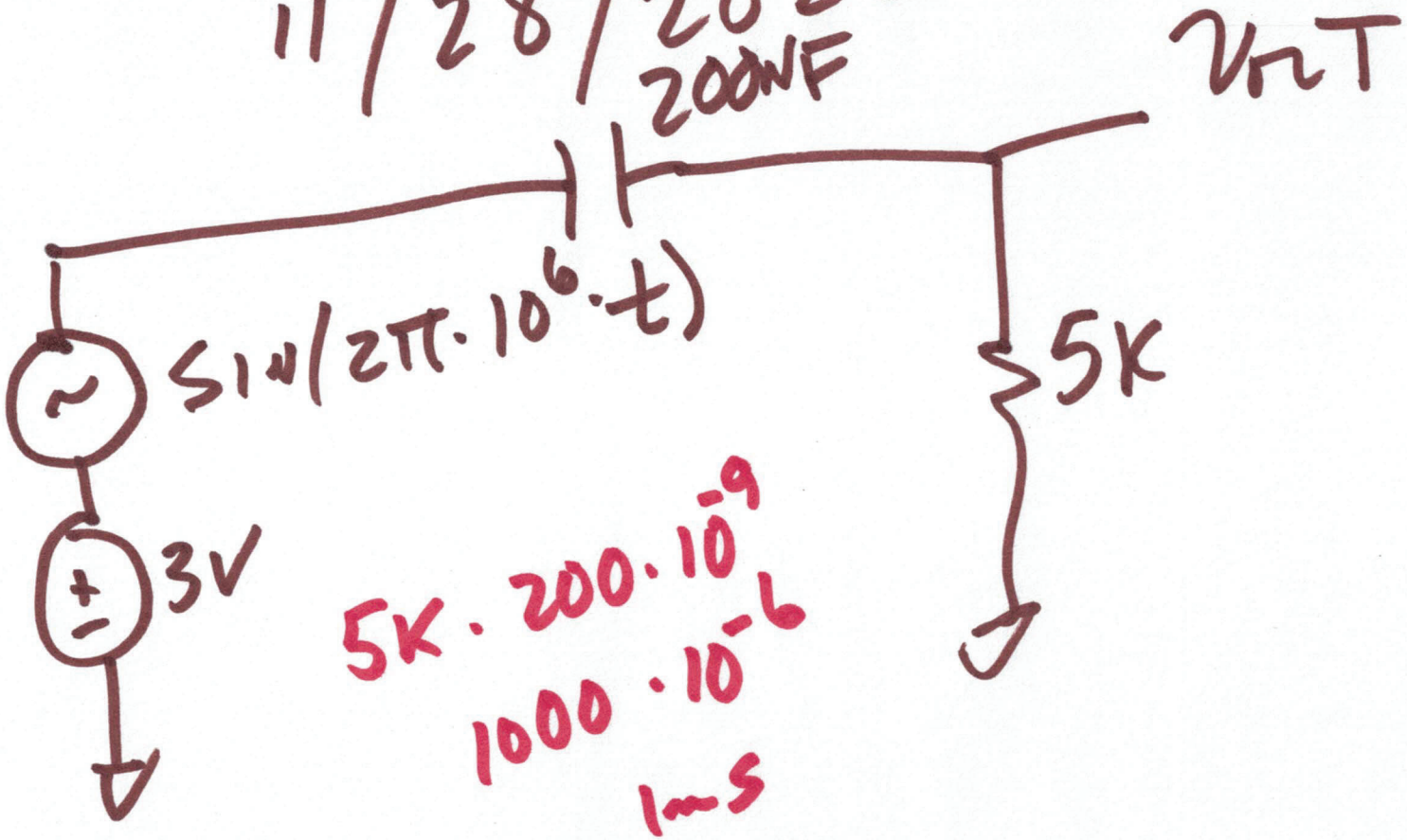
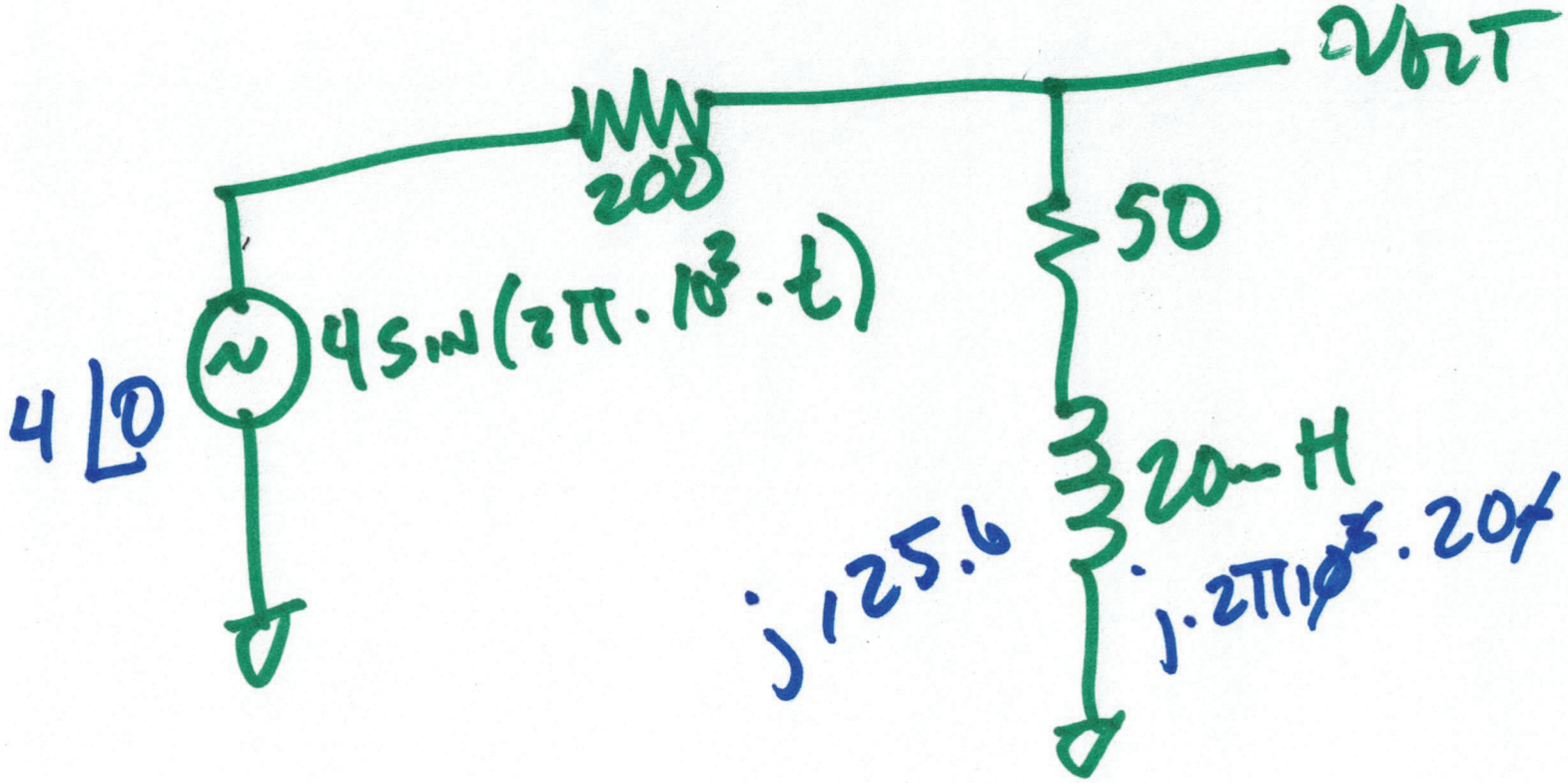
EE 220 CIRCUITS I

Lecture 24

11/28/2022





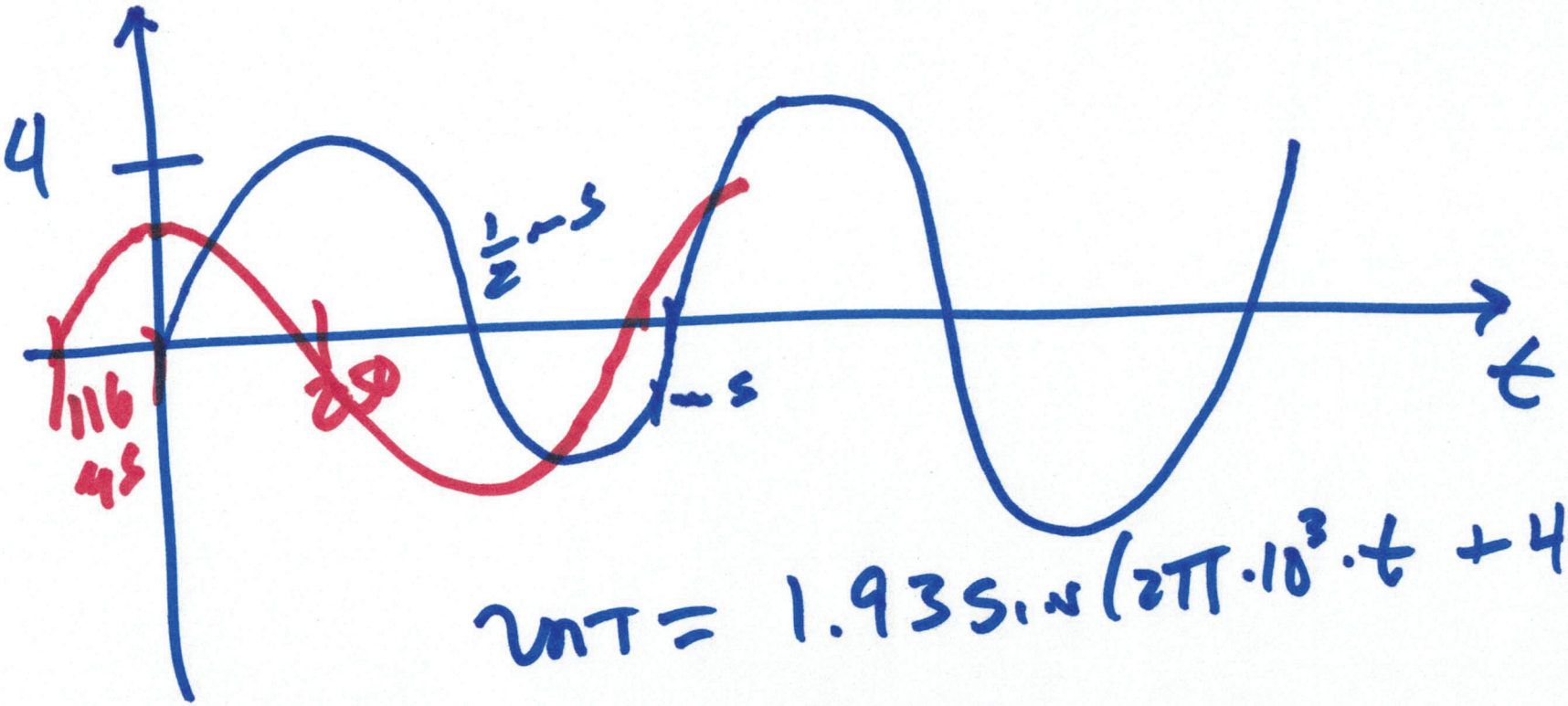
$$V_{OUT} = \frac{50 + j125.6}{200 + 50 + j125.6} \cdot 4\angle 0$$

$$= \frac{135\angle 68.3^\circ}{279.8\angle 24.7} \cdot 4\angle 0$$

$v_{nT} = 1.93 \angle 41.6°$ $\quad f = 10^3 = \frac{1}{10^{-3}} = \frac{1}{T}$

$$41.6 = \frac{t_d}{1ms} \cdot 360$$

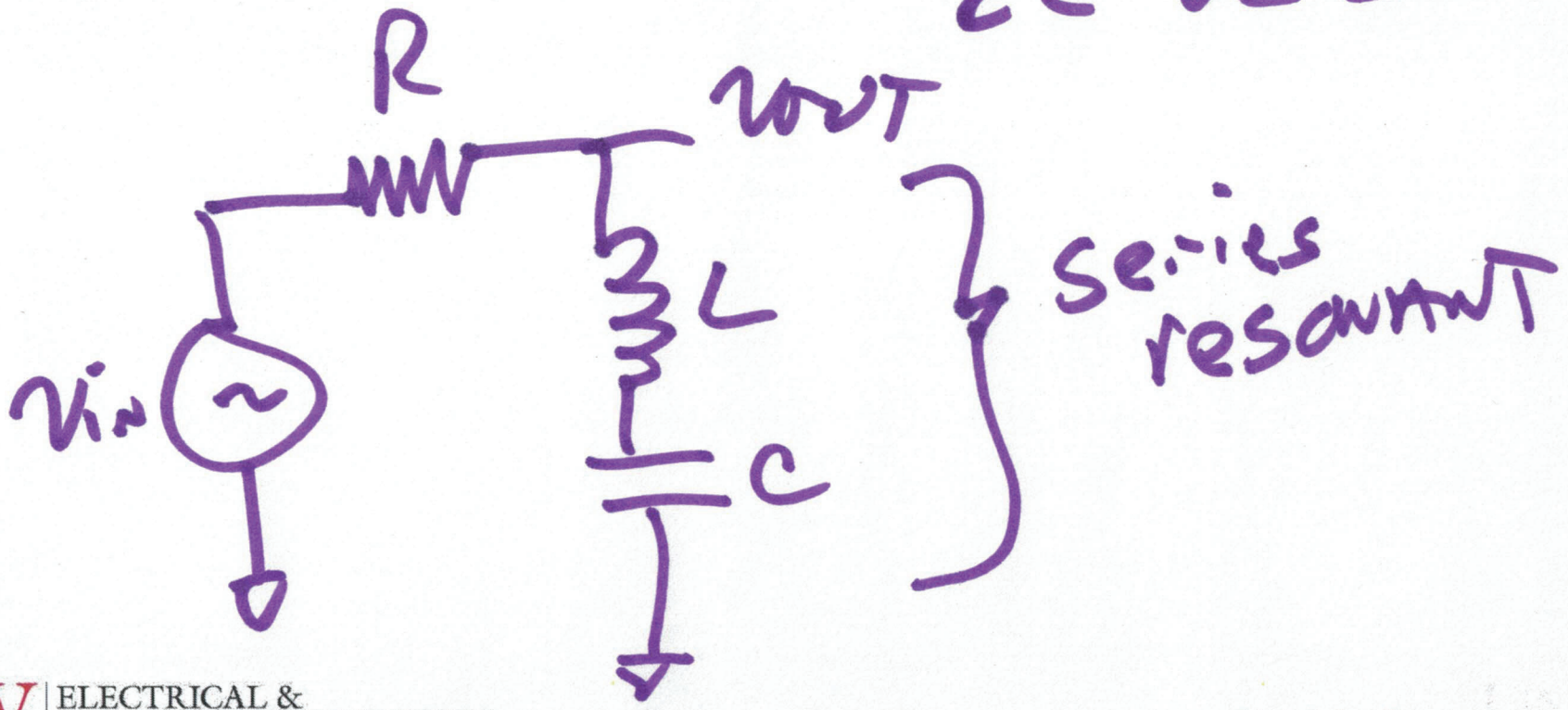
$$t_d = 115.64s = .116ms$$



$$v_{nT} = 1.93 \sin(2\pi \cdot 10^3 \cdot t + 41.6)$$

First-order has a single inductor OR capacitor.

Second-order have 1C 1L or 2C or 2L



$$V_{OUT} = V_{IN} \cdot \frac{jwL + \frac{1}{jwC}}{jwL + \frac{1}{jwC} + R}$$

transfer function

$$\frac{V_{OUT}}{V_{IN}} = \frac{1 + jwL \cdot jwC}{jwL \cdot jwC + 1 + R \cdot jwC}$$

$$= \frac{1 + s^2LC}{s^2LC + 1 + R \cdot sC}$$

$$s = jw = j2\pi f$$

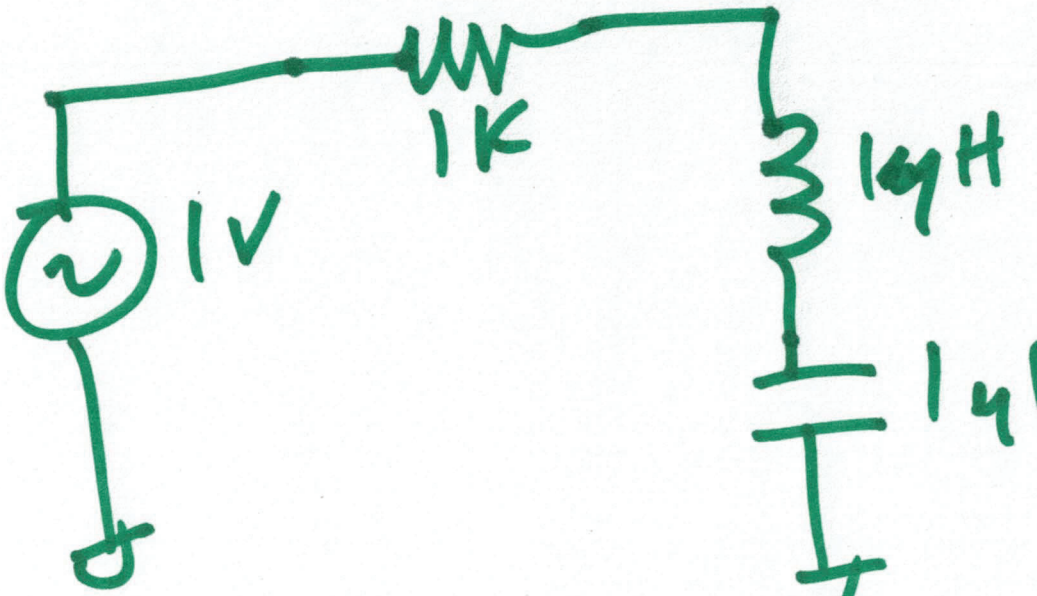
$$\frac{V_{OUT}}{V_{IN}} = \frac{1 - \omega^2 LC}{-\omega^2 LC + 1 + R j\omega C}$$

$1 + j\omega RC = -\omega^2 LC$ parallel

$1 - \omega^2 LC = 0$?

$$\omega = \frac{1}{\sqrt{LC}}$$

$$f = \frac{1}{2\pi\sqrt{LC}}$$



$$f_{Res} = \frac{1}{2\pi\sqrt{10^{-3} \cdot 10^{-6}}}$$

$$= \frac{1}{2\pi \cdot 10^{-6}}$$

$$= 159\,kHz$$

decade → ×10 ÷10

1.23 MHz above
12.3 mHz
.123 mHz below

octave ×2 ÷2

$dB = 20 \log^{volt}$

$20 \log 1V = 0\,dB$

$10 \log V^2$

$20 \log 10^{-6} = -120\,dB$

$20 \log \frac{1}{10} = -20\,dB$

$20 \log 10 = +20\,dB$

10 + 20dB → 10 → -20dB

10 → 10

14dB

5 → 5

6dB

2 → 2

3dB

12

$$\frac{1}{2\pi\sqrt{10^{-6}\cdot 10^{-6}}} = 159\ \text{kHz}$$

Resonance

$v_{out} = v_{in}$

$Z \to$

$$Z = \frac{\frac{1}{j\omega C}\cdot j\omega L}{\frac{1}{j\omega C} + j\omega L} \to 0$$

$$v_{out} = v_{in}\cdot\frac{Z}{R+Z}$$

$$\frac{1}{j\omega C} + j\omega L = 0$$

$$1 + j\omega L\cdot j\omega C = 0$$

$$1 = \omega^2 LC$$

$$f = \frac{1}{2\pi\sqrt{LC}}$$