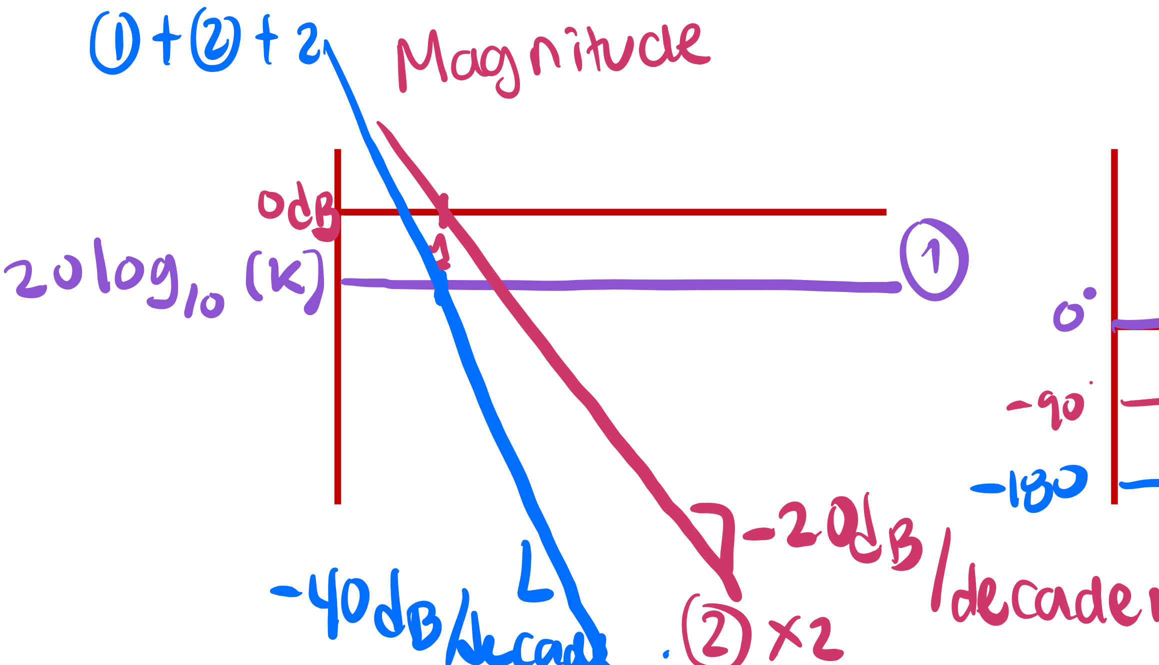
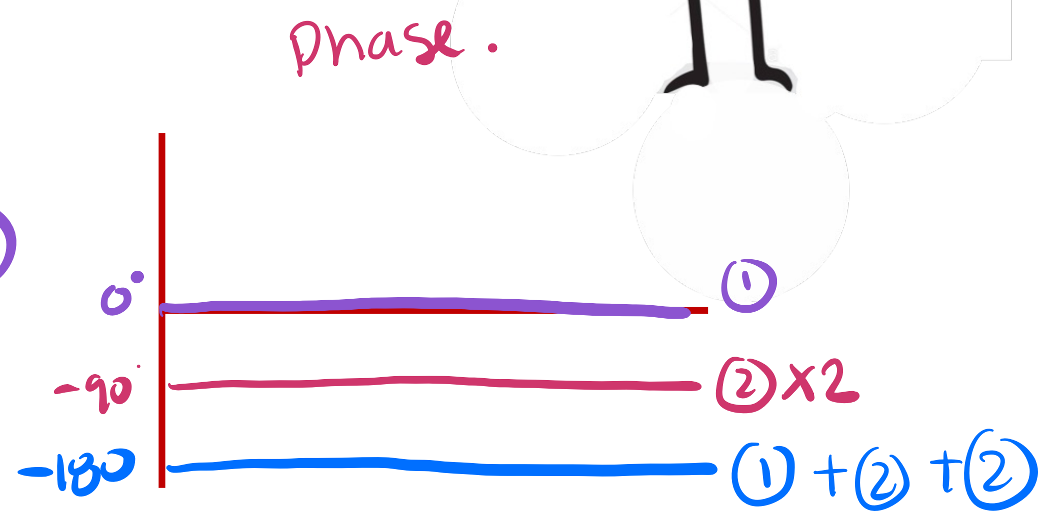
Last Class…

Pole @ the origin:

$$G(s) = \frac{K}{(j\omega)^2}$$

$$= \underbrace{K}_{①} \cdot \underbrace{\frac{1}{jw}}_{②} \cdot \underbrace{\frac{1}{jw}}_{②}$$





THE OHIO STATE UNIVERSITY

COLLEGE OF ENGINEERING

Bode Plot
(Part 2)

Modules 5 - 7

This Lecture…

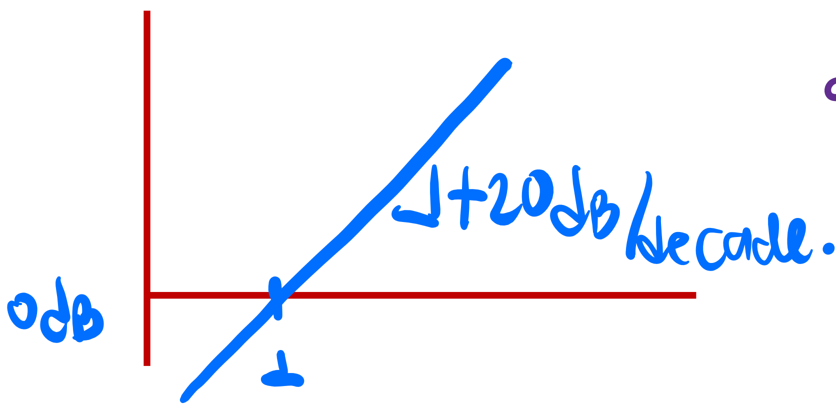
- Learning Objectives:
    - Generate magnitude frequency plots for high and low pass-filters.

Sketch a Bode Plot

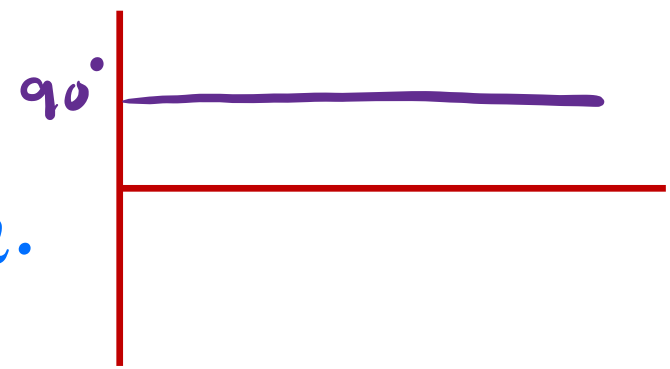
Zero @ the origin:

- $H(s) = j\omega = \dfrac{1}{1/j\omega}$ ← K ← pole @ origin

Magnitude



Phase. $0 - (-90^\circ)$



$$20\log_{10}\left(\frac{M_{num}}{M_{den}}\right) = \cancelto{0}{20\log_{10}(M_{num})} - 20\log_{10}(M_{den})$$

Sketch a Bode Plot

Real Pole:

- $H(s) = \dfrac{1}{1 + \frac{j\omega}{\omega_0}}$

↳ w_0 = pole

poles: $1 + \dfrac{x}{w_0} = 0$

$\dfrac{x}{w_0} = -1$

$x = -w_0$

↳ critical frequencies

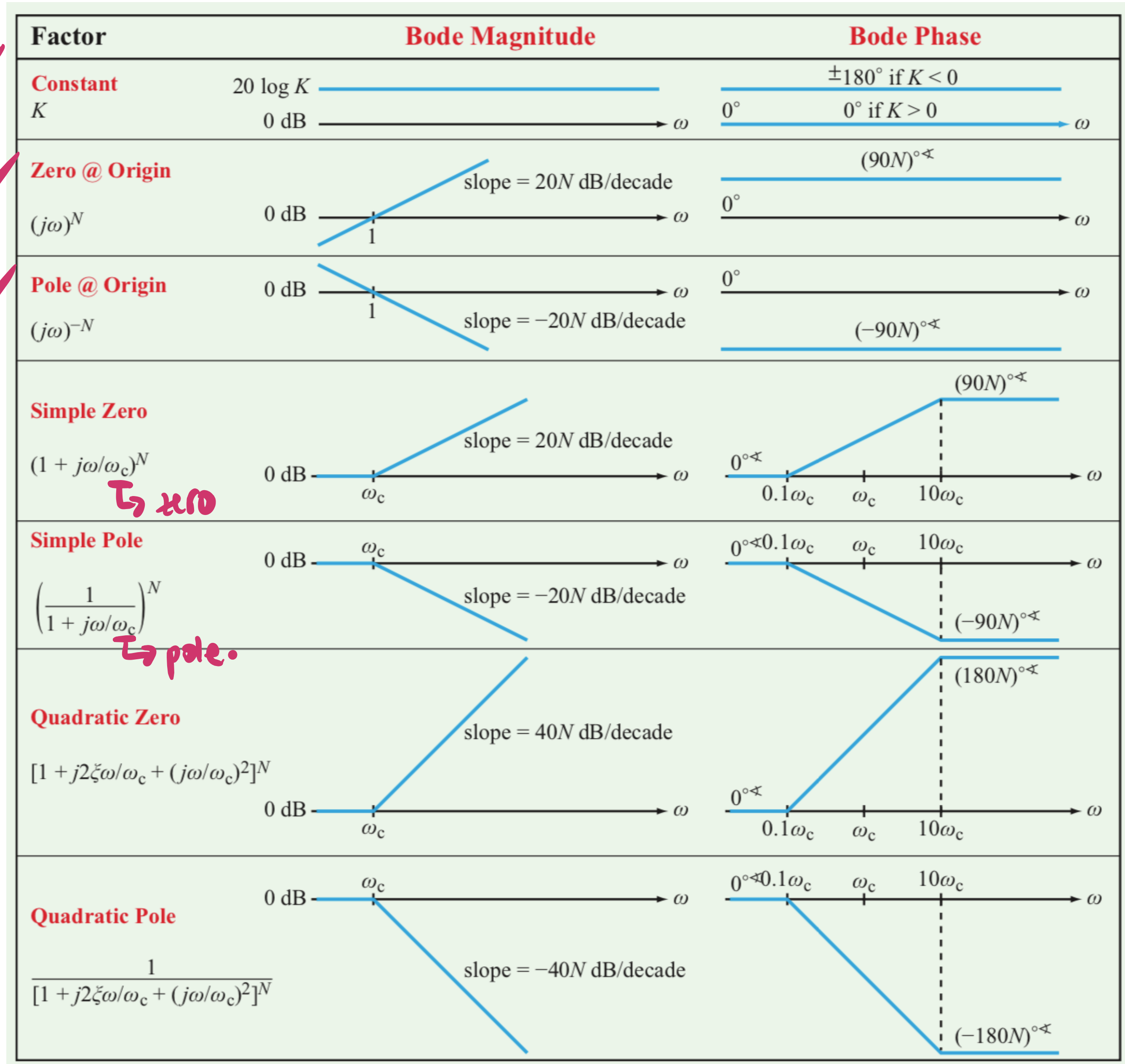
LPF $\dfrac{1}{1 + jwCR}$

$1 + jw$

$w_0 = \dfrac{1}{} = \dfrac{1}{CR}$

↑ pole

Sketch a Bode Plot



1 + jw

↳ zero

↳ pole.

Example 1

HPF $\dfrac{j\omega CR}{1+j\omega CR}$

$$CR \cdot j\omega \cdot \frac{1}{1+j\omega CR}$$

① constant K

$CR = 0.1$

$\Downarrow$

$K = 0.1$

$20\log_{10}(0.1) = -20\,\mathrm{dB}$

② zero @ zero

$\downarrow$

$w_1 = 0$

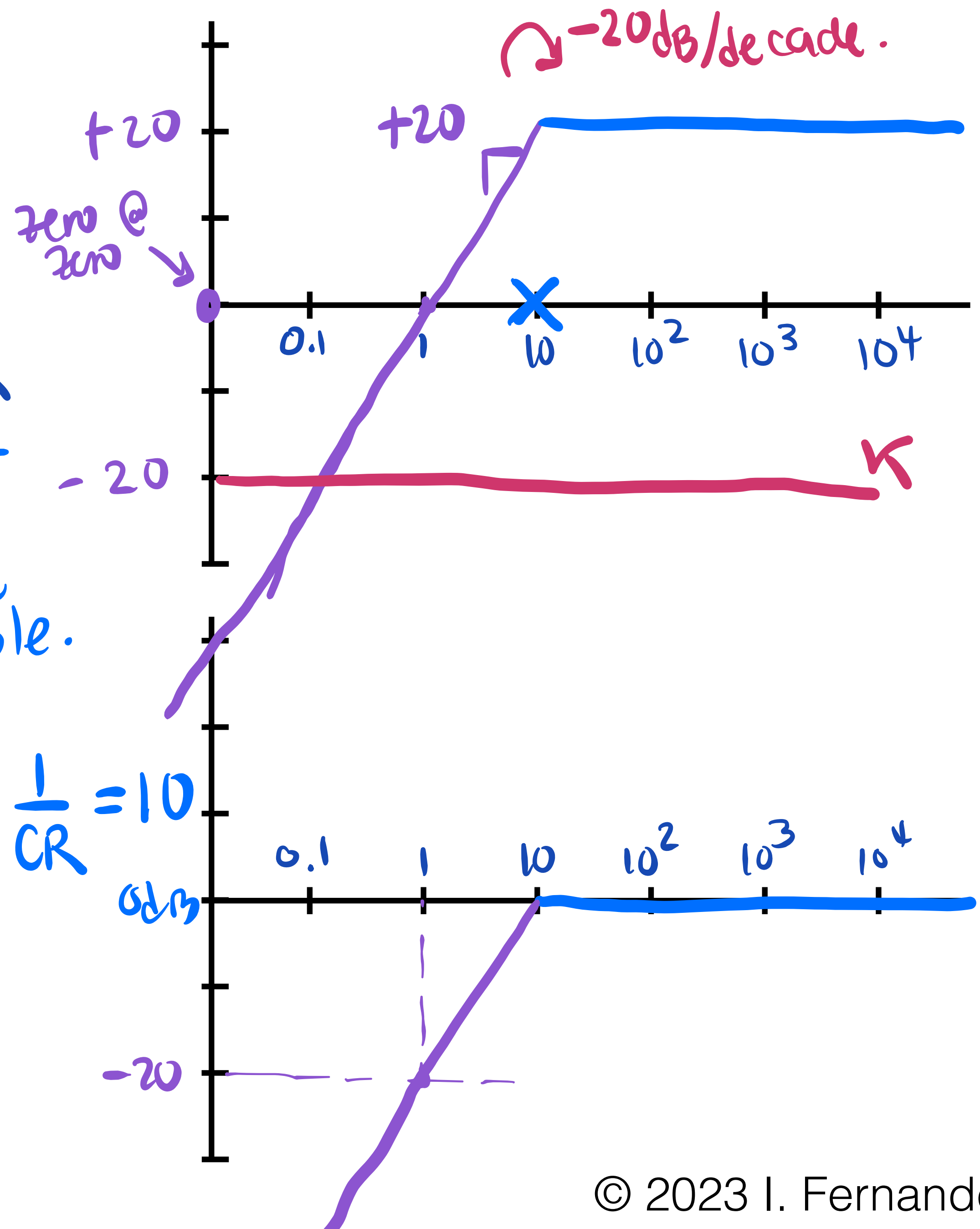
O

③ simple pole.

$\downarrow$

$w_2 = \dfrac{1}{CR} = 10$

X



Example 3

$$H(s) = \frac{5 + jw}{1 + jw10}$$

$$= \frac{5(1 + jw0.2)}{1 + jw10}$$

$$= \underbrace{5}_{①} \cdot \underbrace{(1 + jw0.2)}_{②} \cdot \underbrace{\frac{1}{1 + jw10}}_{③}$$

① K

$20\log_{10}(5)$
$\parallel$
13.99

② simple zero

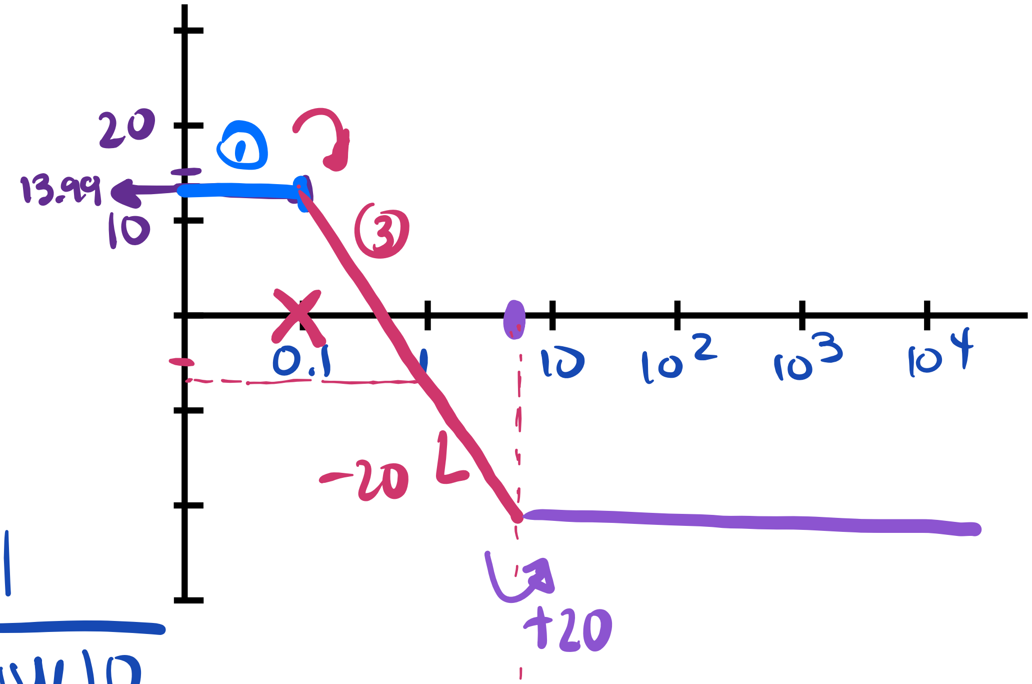
$w_1 = \frac{1}{0.2}$

$= 5$

③ simple pole.

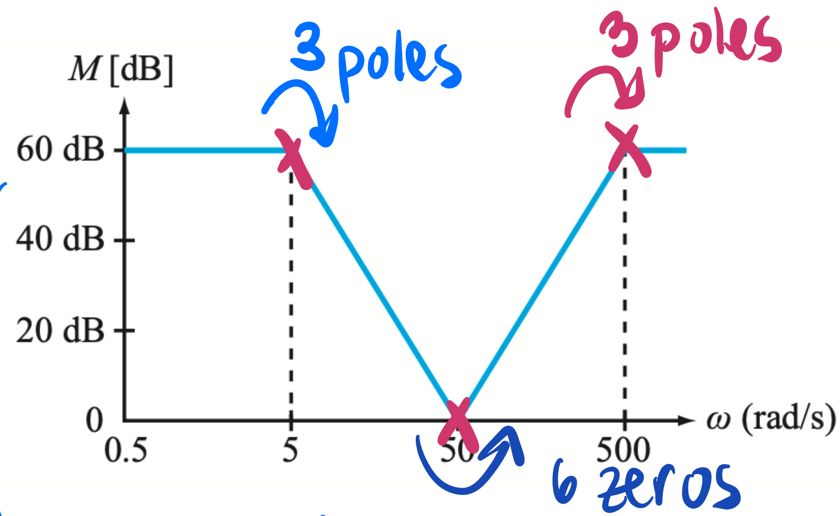
$w_2 = \frac{1}{10}$

$= 0.1$



Example 3

Determine the voltage transfer function H(ω) corresponding to the Bode magnitude plot shown



$$H(j\omega) = ???$$

$$= \frac{10^3 \left(1 + j\omega/50\right)^6}{\left(1 + j\omega/5\right)^3 \left(1 + j\omega/500\right)^3}$$

$$60 = 20\log_{10}(K)$$

$$3 = \log_{10}(K)$$

$$10^3 = K$$

Example 4

$$H(j\omega) = ???$$

$$= \frac{10 j\omega \, (1 + j\omega/10)^2}{(1 + j\omega)\,(1 + j\omega/100)^2}$$