MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science

6.003: Signals and Systems—Fall 2002

Tutorial for the week of November 25th - November 29th

Alex's Office Hours
Monday 3-5pm

Important Due Dates:

- Problem Set 9 due on Wednesday.

Today

1. Pole-Zeros to Bode Plot example
2. Z-Transform stuff

More on CT Frequency response

You should feel comfortable understanding how a system is characterized in many different forms:

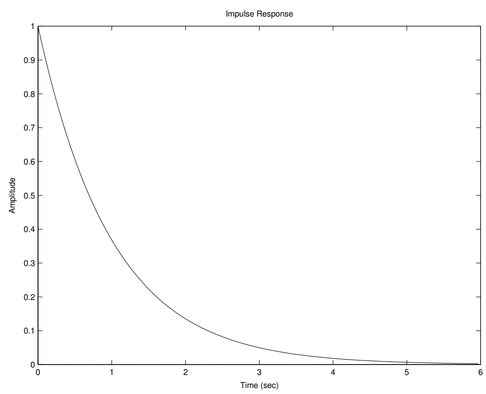
1. System Function, $H(s)$ eg:

$$H(s) = \frac{1}{s+1}, \qquad \mathrm{Re}(s) > -1$$

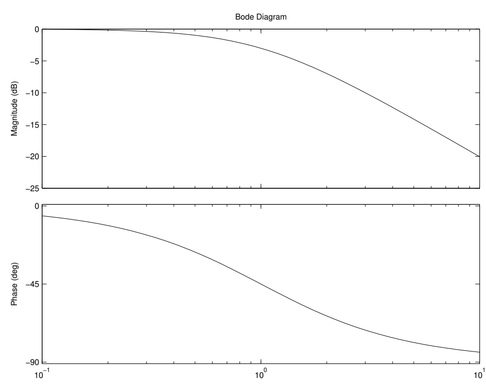
2. Impulse response, $h(t)$

$$h(t) = e^{-t}u(t)$$

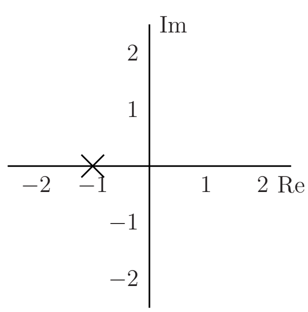
3. Graph of impulse response, or step response



4. Bode plot



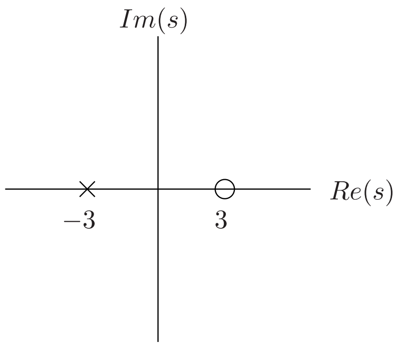
5. Pole zero diagram



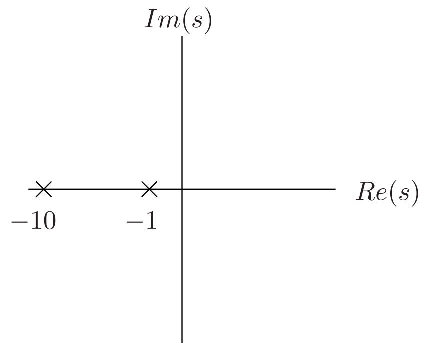
[Example]

All the fun you can have with pole-zero diagrams and bode plots. Match the pole-zero diagrams on this page with the the frequency response plots on the next page:

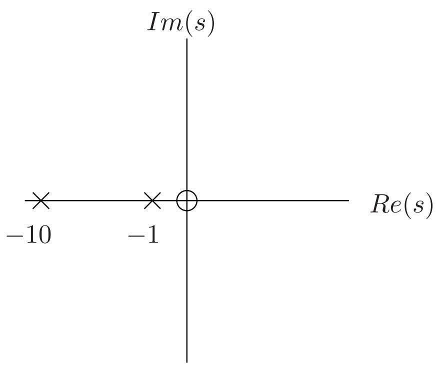
(a)



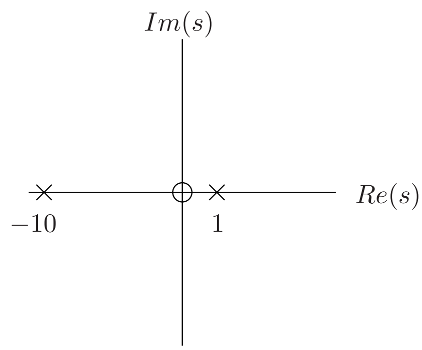
(b)



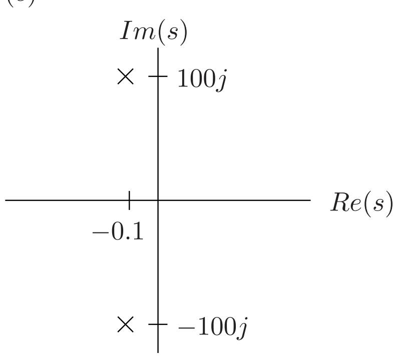
(c)



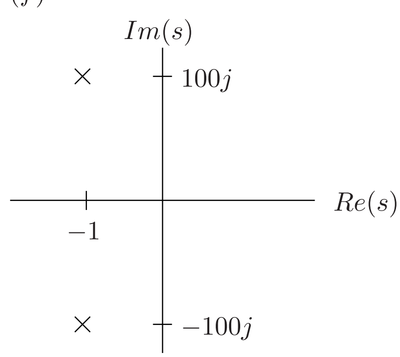
(d)

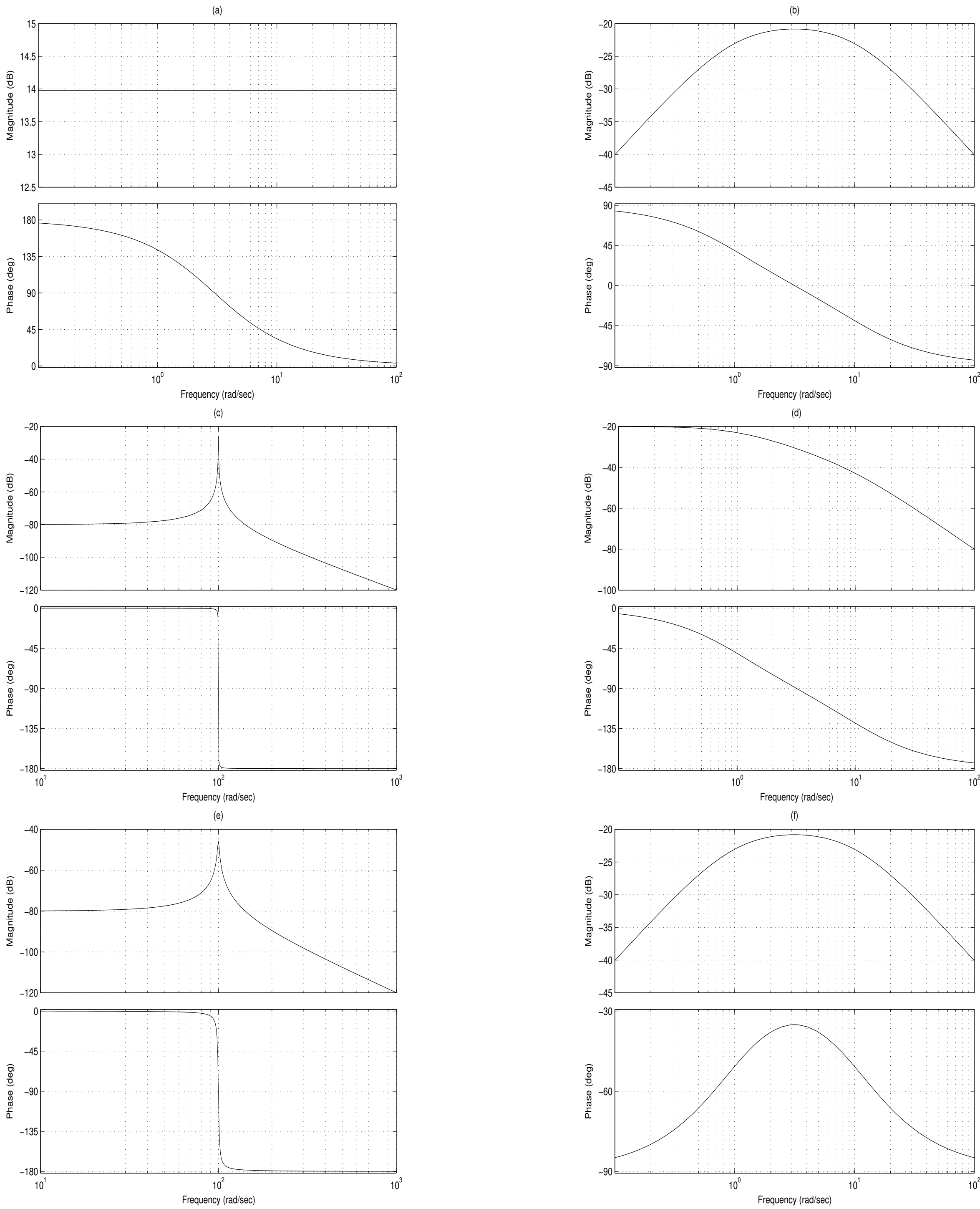


(e)



(f)




(a)
(b)
(c)
(d)
(e)
(f)
Magnitude (dB)
Phase (deg)
Frequency (rad/sec)

[Example]

Given the z-transform pair

$$x[n] \leftrightarrow \frac{z}{z^2+4}, \quad |z| > 2$$

use z-transform properties to determine the z-transform of the following signals:

(a) $y[n] = 2^n x[n]$

(b) $y[n] = x[n+1] + x[n-1]$

(c) $y[n] = \underbrace{x[n] * x[n] * \cdots * x[n]}_{m \text{ times}}$

(d) $y[n] = (n-3)x[n-2]$

Work Space

[Example]

Determine all possible signals that can have the following z-transforms with the given conditions.

(a) $\frac{1}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$

(b) $\frac{2-\frac{3}{2}z^{-1}}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$, causal

(c) $\frac{3}{1-\frac{10}{3}z^{-1}+z^{-2}}$, stable

(d) $\frac{1-\frac{1}{2}z^{-1}}{1+\frac{1}{2}z^{-1}}$, right-handed

Work Space