Professor Fearing EECS120/Problem Set 11 v 1.0 Fall 2016

Due at 4 pm, Fri. Nov. 18 in HW box under stairs (1st floor Cory)

1. (20 pts) Frequency and Phase response using graphical techniques. (Lec 19,OW 9.4)

For each transfer function below (all are causal and at least marginally stable):

a. sketch the pole-zero diagram.

b. sketch the magnitude and phase response of $H(j\omega)$ on linear-linear scale, using the approximate methods discussed in class and the lecture notes.

c. sketch the impulse response of the system.

$H_1(s) = \frac{1}{(s+1)(s+2)}$ $H_2(s) = \frac{s+1}{s+2}$ $H_3(s) = \frac{s+4}{(s+1)^2}$ $H_4(s) = \frac{1}{s^2+2s+5}$

2. (24 pts) (Lec 19, OW 9.4)

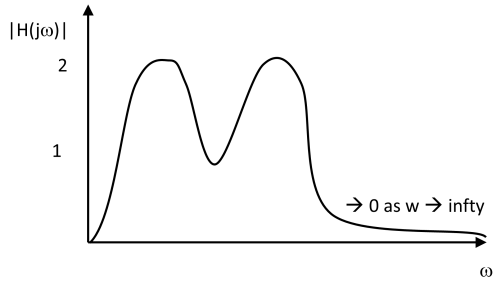
Consider the frequency response of a real, stable system shown below.

a) Explain why the number of poles must be greater than the number of zeros.

b) Explain why the poles and zeros must be either on the real axis or appear as complex conjugates.

c) Sketch a pole-zero diagram for a stable system (using a minimum number of poles and zeros) which would have the given frequency (magnitude) response. (The topology of pole-zero locations for this problem is more important than precise locations).

d) Sketch the phase response for this pole-zero diagram. Is the phase response unique for this magnitude response?



3. (16 pts) Lec 20, OW 9.5.10.

Find the initial and final value for $x(t)$ given the causal Laplace transforms $X(s)$:

a) $\frac{s}{(s+2)(s+3)}$ b) $\frac{1}{s(s+1)}$ c) $\frac{s-1}{s(s+1)}$ d) $\frac{s-1}{(s+2)(s+3)}$

4. (10 pts) Z transform Lec 20 OW 10-10.2

Find the Z transform and region of convergence for the following functions:

a) $x[n] = 2^n u[n]$ b) $x[n] = 0.5^n u[n]$.

5. (15 pts) DTFT Lec 20, OW 10.4

Sketch the pole-zero diagram and $|X(e^{j\omega T})|$ for the following functions:

a) $X(z) = \frac{z}{z+3/4}$ b) $X(z) = \frac{20}{(z-0.5)(z-0.9)}$ c) $X(z) = \frac{(z-\frac{1}{2})(z+\frac{1}{2})}{(z+\frac{3}{4}e^{j\pi/4})(z+\frac{3}{4}e^{-j\pi/4})}$

6. (15 pts) IVT, FVT Lec 20, OW 10

Find the initial and final value for $x[n]$ given the causal Z transforms $X(z)$:

a) $X(z) = \frac{z}{z+3/4}$ b) $X(z) = \frac{20}{(z-0.5)(z-1)}$ c) $X(z) = \frac{(z-\frac{1}{2})(z+\frac{1}{2})}{(z+\frac{3}{4}e^{j\pi/4})(z+\frac{3}{4}e^{-j\pi/4})}$