ECE 321: Handout #10

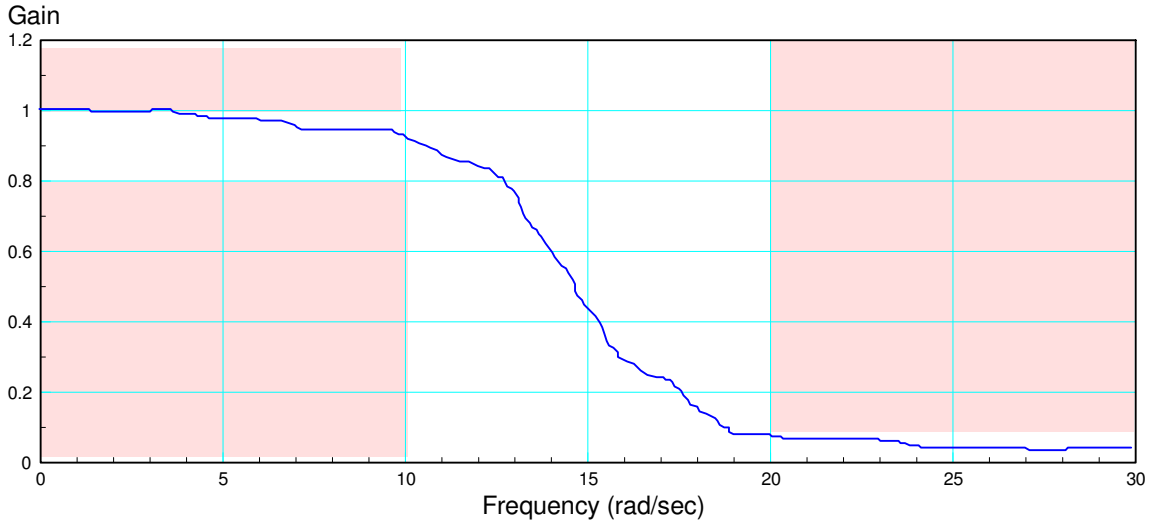
Fitler Design

Design a low-pass filter to meet the following specifications

- DC gain $\approx$ 1.000
- 0. gain 1.0 for frequencies below 10 rad/sec
- gain 0.1 for frequencies above 20 rad/sec

a) Determne the number of poles needed

b) Give the transfer funciton of a Butterworth filter which should come close to meeting these requirements



Solution

The number of poles needed are

$$\left(\frac{10\frac{rad}{\sec}}{20\frac{rad}{\sec}}\right)^{n} < 0.1$$

$$n > \ .\ 22$$

Let n= . A th-order Butterworth fitler with a corner at 1 rad/sec is

$$G(s) = \left(\frac{1}{\left(s+1\angle\pm 22.\ ^{0}\right)\left(s+1\angle\pm\ \ .\ ^{0}\right)}\right)$$

A th-order Butterworth filter with a corner at 12 rad/sec is

$$G(s) = \left(\frac{12^{}}{\left(s+12\angle\pm 22.\ ^{0}\right)\left(s+12\angle\pm\ \ .\ ^{0}\right)}\right)$$

12 is just a guess

- Something more than 10 and less than 20
- I d have to use matlab to itterate from here

```
w   [0 0.1   0]
p1   1?*exp j*??. *pi/1 0)
p?   conj p1)
p    1?*exp j*  . *pi/1 0)
p    conj p )
s   j*w
G   1?^  ./    s+p1).* s+p?).* s+p ).* s+p ) )
plot w,abs G))
plot w,abs G),10,0. , x ,?0,0.1, x )
```