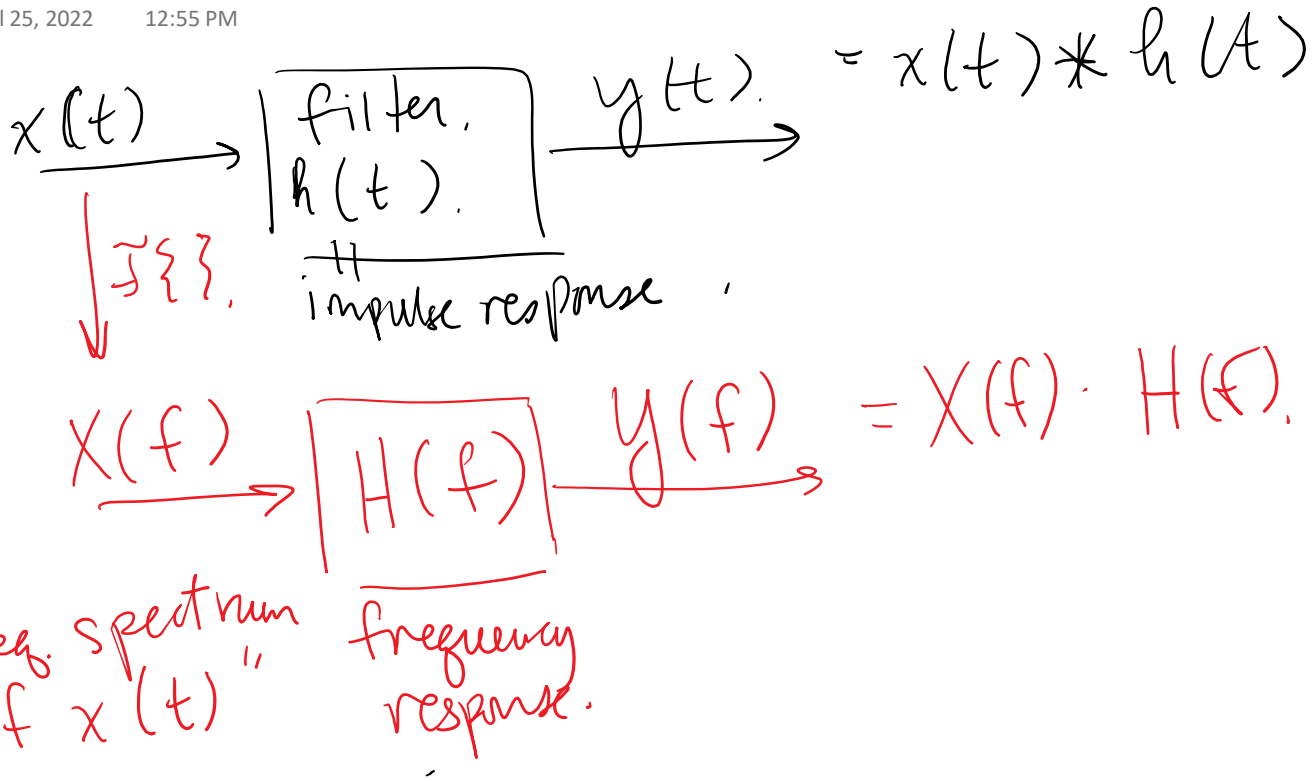
Frequency response

Monday, April 25, 2022 12:55 PM



IIR

Monday, May 2, 2022 3:16 PM

$$H(f) = H(z)\Big|_{e^{j2\pi f}} = \frac{b_0 z^0 + b_1 z^{-1} + b_2 z^{-2} + \cdots}{a_0 z^0 + a_1 z^{-1} + \cdots}$$

When $a_0 = 1$ & a_1 onward $= 0$:

$$y[n] = b_0 x[n] + b_1 x[n-1] + \cdots$$

$\Rightarrow$ non-recursive = FIR.

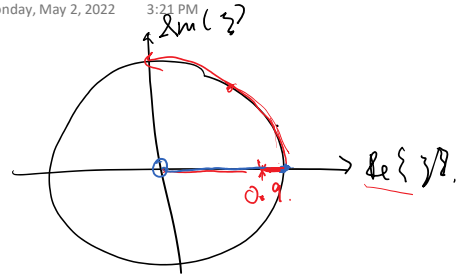
$\rightarrow$ IIR = recursive

$\Rightarrow$ non-zero $a_1, a_2 \cdots$

e.g. $H(z) = \frac{1}{1 - 0.9 z^{-1}} = \frac{z}{z - 0.9}$

IIR filter design

Monday, May 2, 2022 3:21 PM



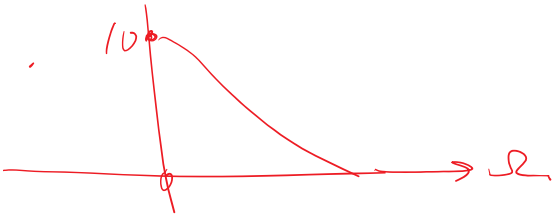
$$H(z) = \frac{(z-z_1)(z-z_2)\cdots(\ )}{(z-p_1)(z-p_2)\cdots(\ )}$$

$$H(z) = \frac{z}{z-0.9}$$

Zeros of $H(z)$: values of z that make $H(z) = 0$ ≡ where numerator $= 0$.

Poles of $H(z)$: values of z that make $H(z) \to \infty$ ≡ where denom $= 0$.

$$H(z = e^{j\Omega}) \text{ @ } \Omega = 0 \quad = \frac{1}{0.1} = 10$$



High pass IIR

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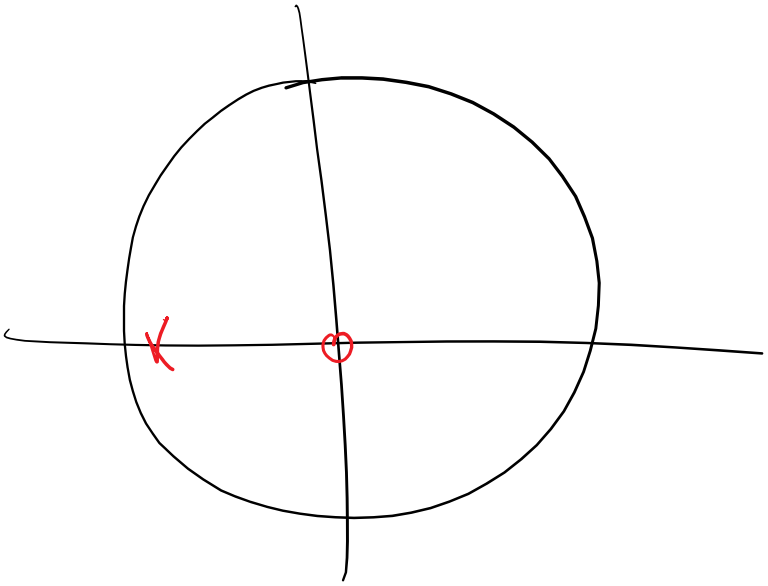

Filter types

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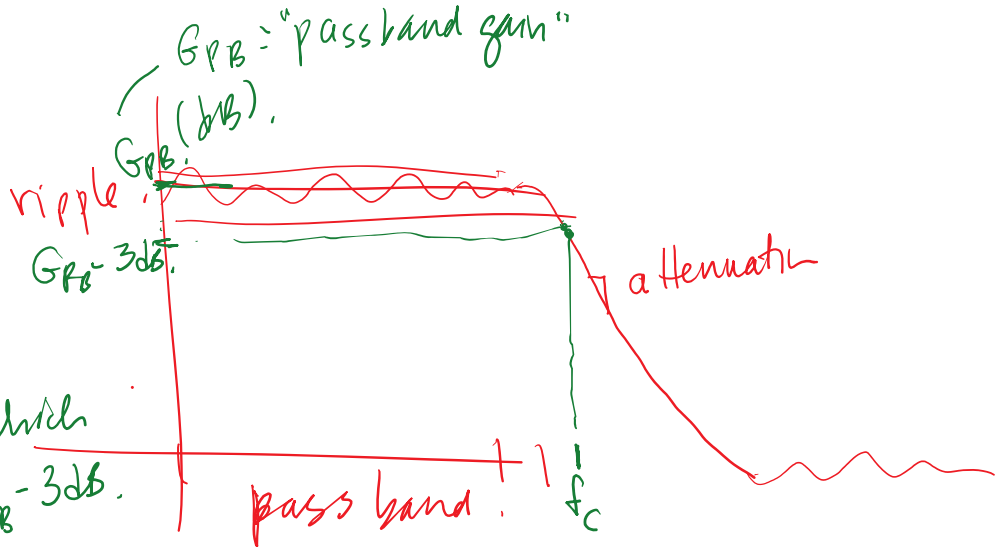
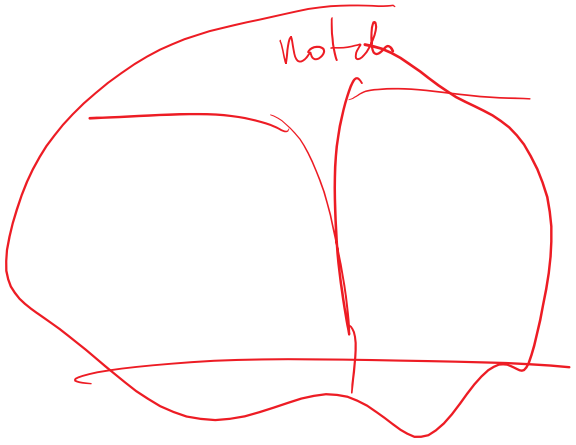
Butterworth

Elliptical

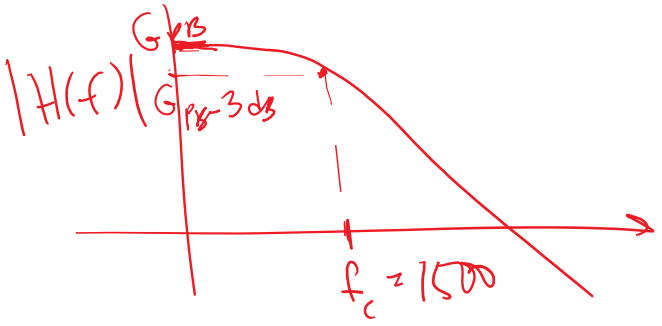
Chebychev I and II

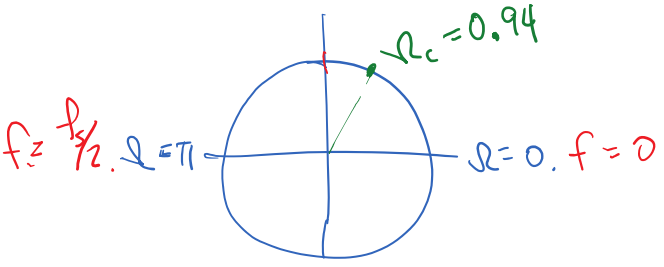


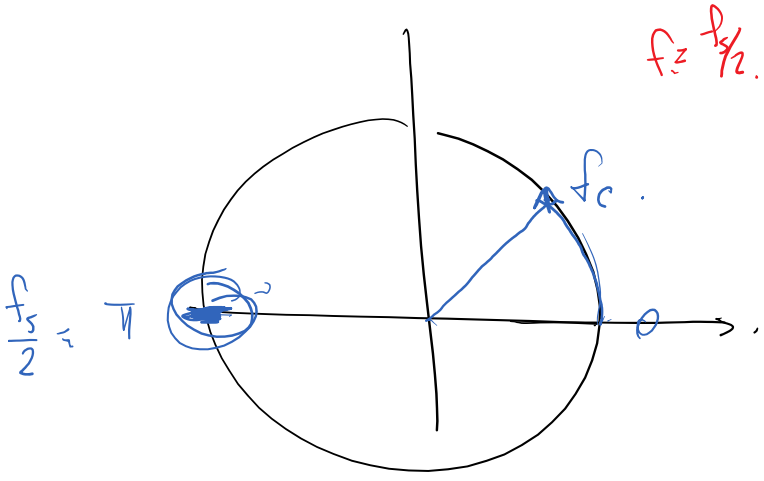
Butter(order of filter, cutoff frequency/ies)



example: $f_s = 10$ kHz.







Omega to f in Hz

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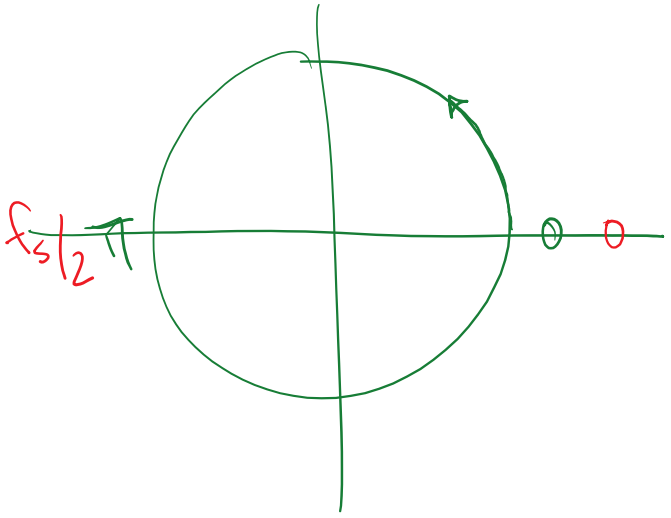

Ω rad/samp. $\longrightarrow$ f in Hz.

$$f = \frac{\Omega}{\pi} \cdot f_s/2.$$

$$= \frac{\Omega}{2\pi} \cdot f_s.$$