1. Dual of a series RLC filter is a parallel RLC network as shown below:

$$i_{in}(\omega) \quad L \quad C \quad R \quad V_0(\omega) \quad , \quad H(s) = \frac{V_0(s)}{i_{in}(s)}$$
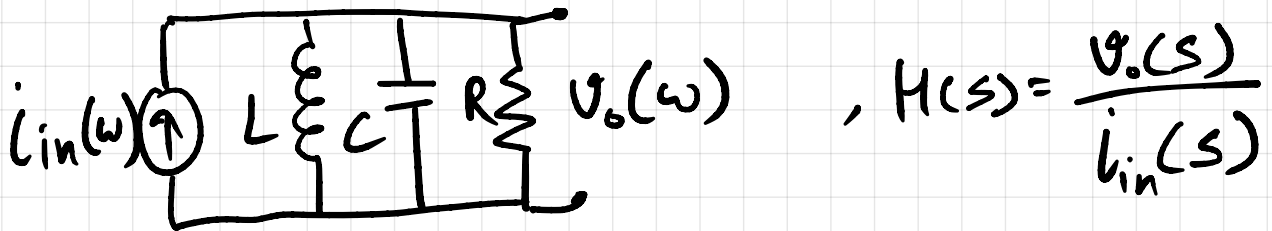
Find the transfer function H(s), Q of the network and 3dB bandwidth.

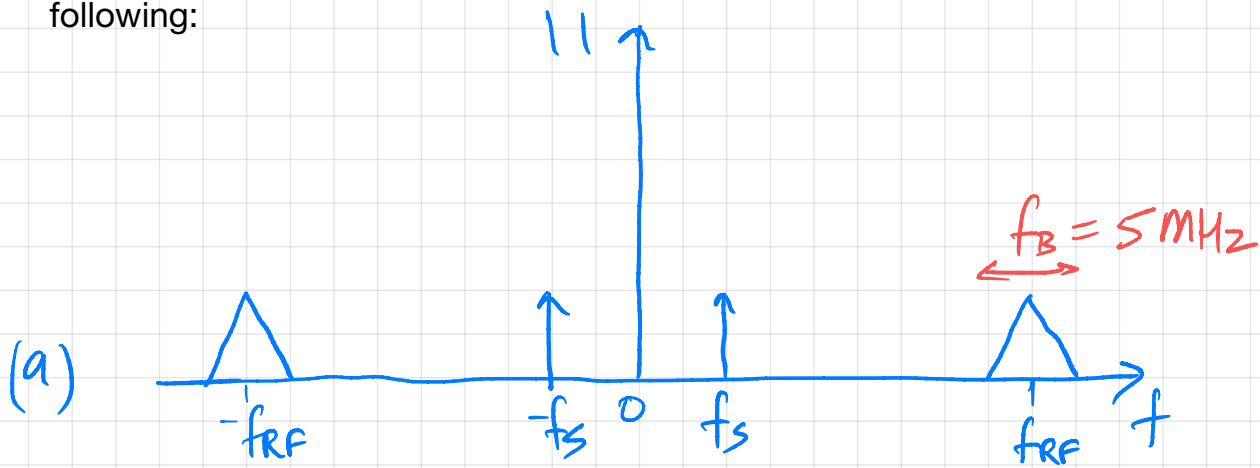2. Below is an approximate frequency response of a first order low-pass filter:
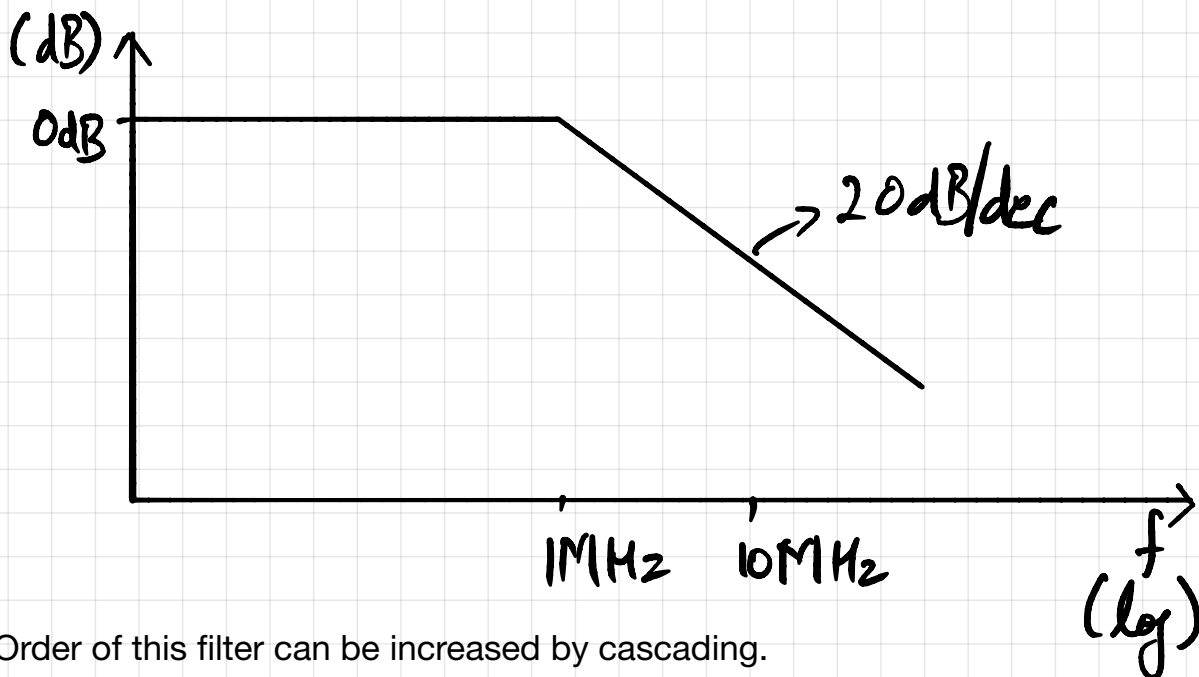
Order of this filter can be increased by cascading.

(a) What should be the order such that when roll-off starts at 1MHz, 40dB attenuation is achieved at 10MHz?
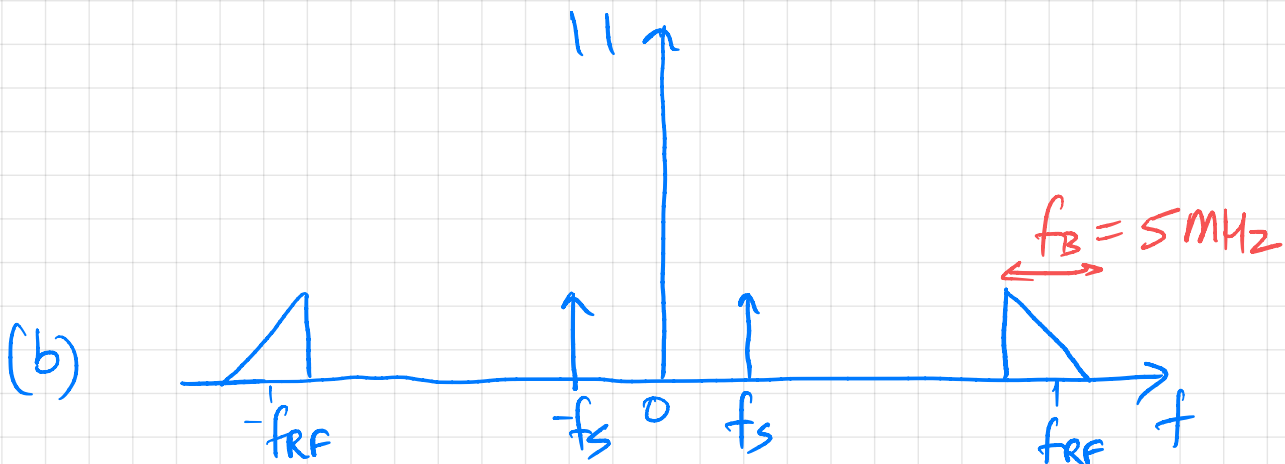
(b) Find the order when filter roll-off starts at 100MHz and 40dB attenuation is required at 109MHz.

3. Draw the spectrum of sampled output showing at least three alias bands for the following:

(a)

$f_B = 5MHz$

$-f_{RF}$ $-f_s$ 0 f_s f_{RF} f

Case I → $f_s = 5MHz$, $f_{RF} = 1GHz$

Case II → $f_s = 5MHz$, $f_{RF} = 1GHz + 3MHz$

(b)

$f_B = 5MHz$

$-f_{RF}$ $-f_s$ 0 f_s f_{RF} f

Case I → $f_s = 5MHz$, $f_{RF} = 1GHz$

Case II → $f_s = 5MHz$, $f_{RF} = 1GHz + 3MHz$

What is the minimum fs to avoid signal corruption in all the above cases?

4. Below is the frequency details of an RF band:

Centre frequency=1GHz, span=100MHz, channel bandwidth=10MHz.

Channel select filter is chosen to operate at 300MHz with 10MHz bandwidth.

(a) Find the range of LO frequency to cover the entire band.
(b) Find the centre frequency and span of image.