5 FILTER DESIGN

- It is very common to design filters with passband - stopband characteristics, such as lowpass, highpass, bandpass, band reject.

- In this section, you will learn to start with the filter specs, then obtain the numerator and denominator polynomials of a suitable transfer function, and then design a circuit that realizes the desired filter.

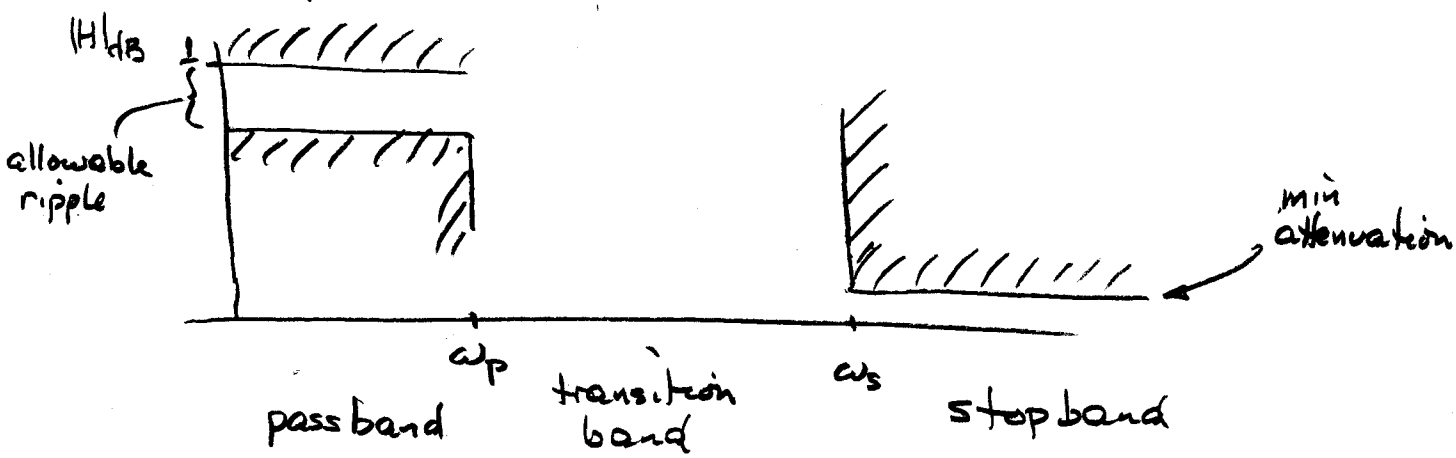
- Refs: - DC & L Chapter 21

  - Ziemer, Tranter and Fannin, Signals and Systems: Continuous and Discrete (Appendix D), MacMillan 1998.

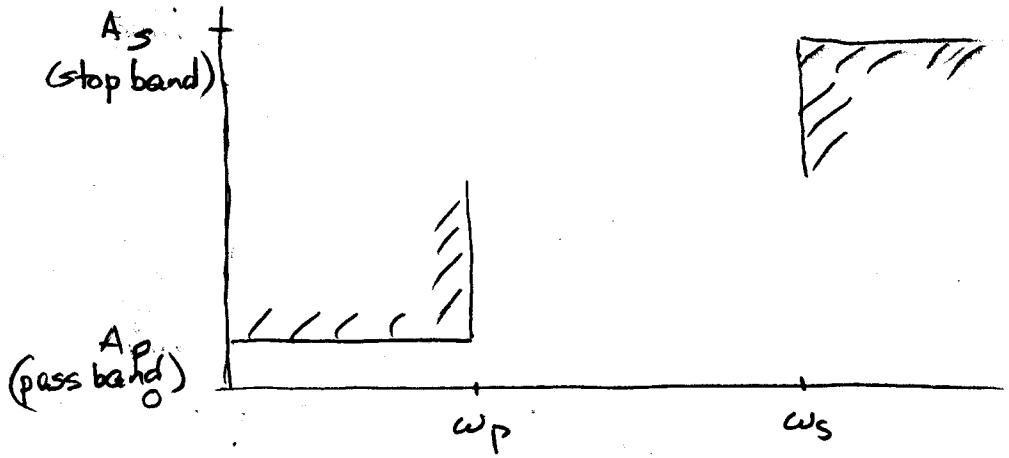
  - FP Tedeschi, The Active Filter Handbook, TAB Books, 1979

5.1 General Approach

- The specifications for a low pass filter are typically like this

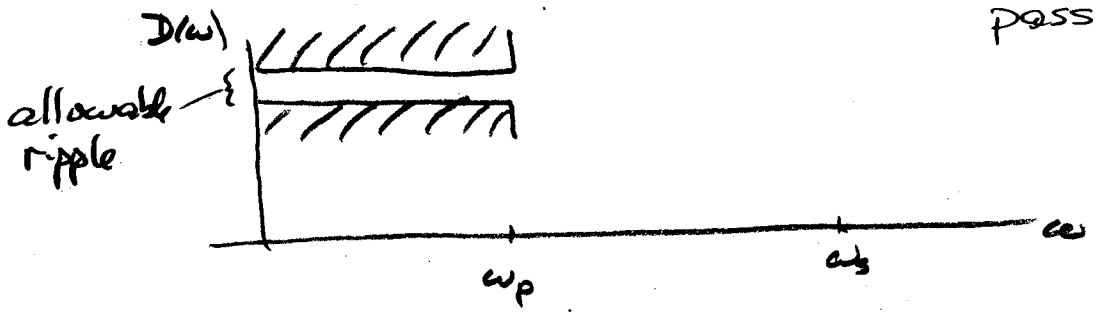


though sometimes inverted to work with loss or attenuation, a positive quantity $A(\omega) = -20\log(|H(j\omega)|)$

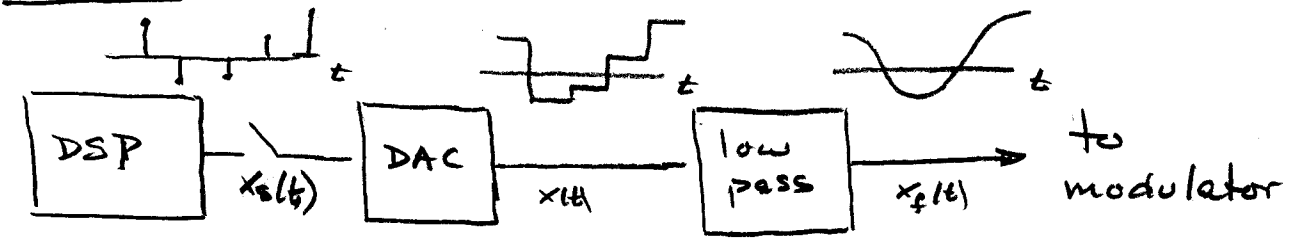


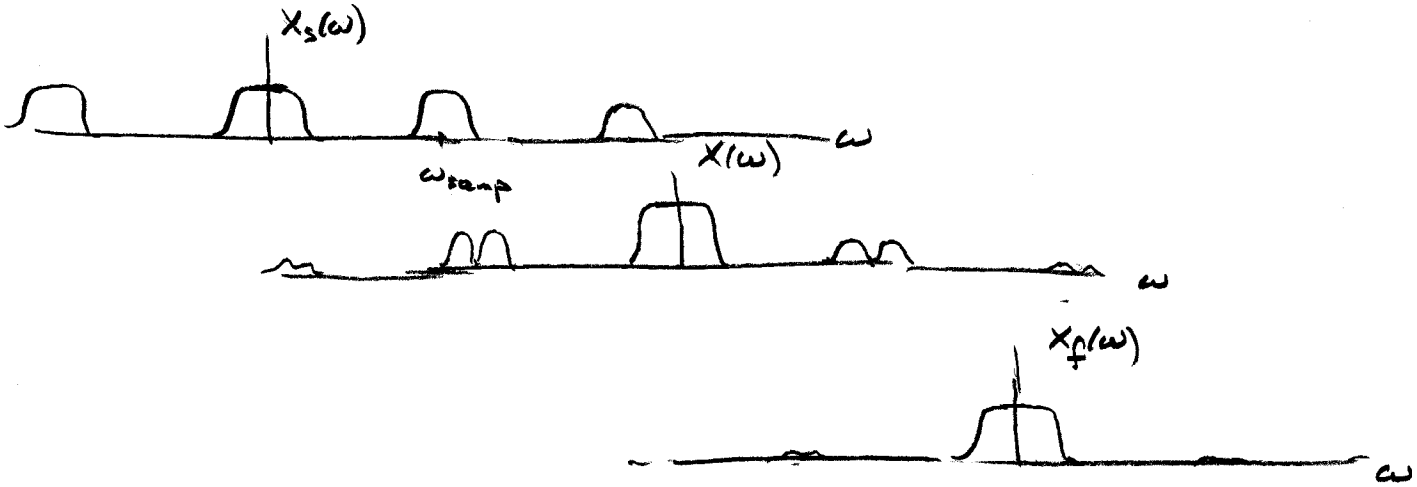
- Sometimes also restrictions on group delay variations

pass band only

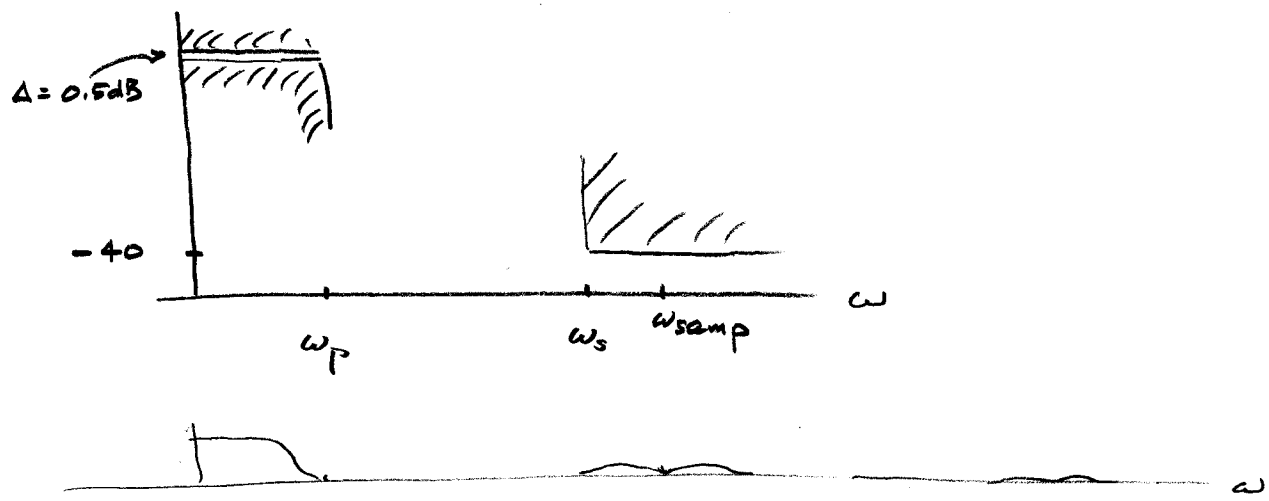


example reconstruction filter for radio modem.





low pass might be allowed 0.5 dB ripple peak to peak in the pass band, and have to provide at least 40 dB attenuation of all images



- Select a type of filter from well-studied alternatives on the basis of their characteristics

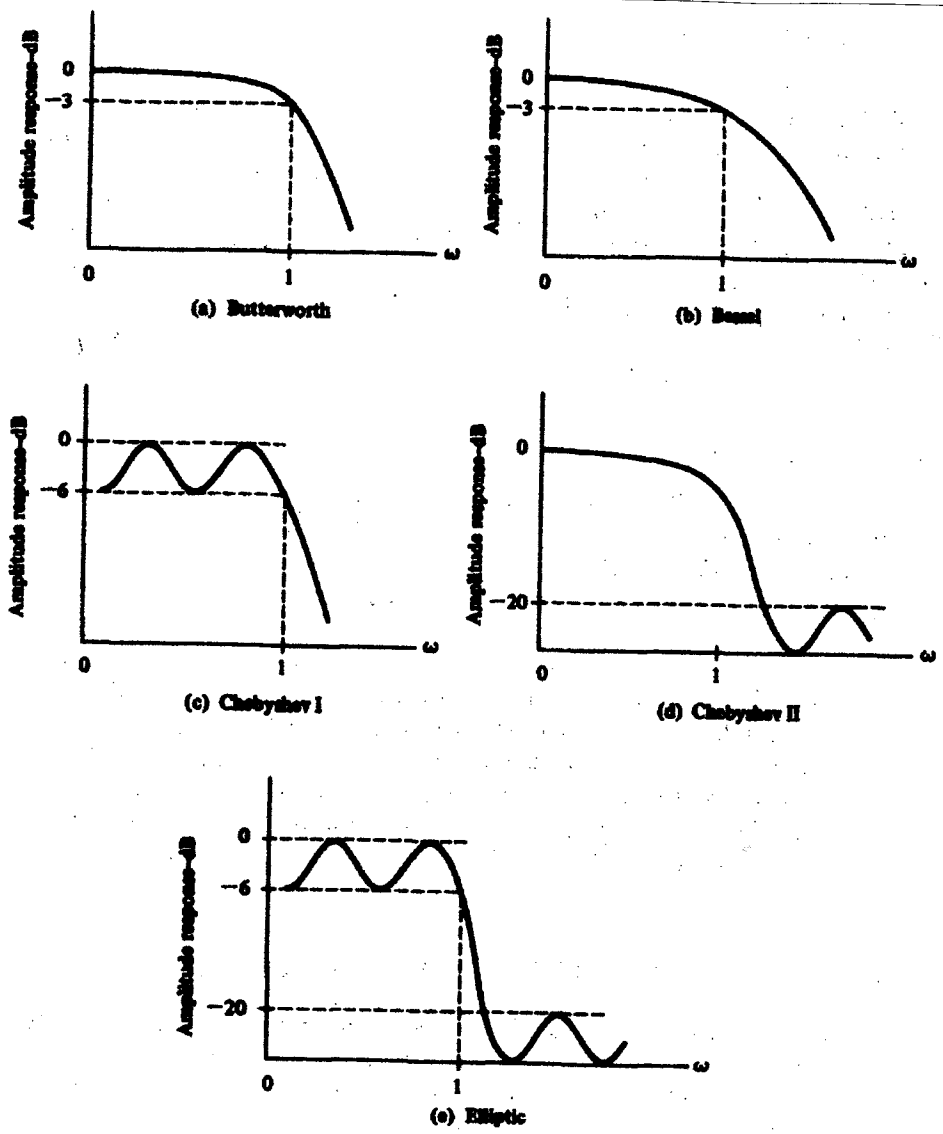


FIGURE D-2. Amplitude response of various prototypes. (all 4th order)

Their polynomials are tabulated for various orders and ripples, normalized to passband $\omega_p = 1$

- Frequency · scale your specs to unit passband or scale the filter to your specs,
- Choose the filter order
  - by cut and try
  - or by formula

  Since order is an integer, you may have to go higher than a formula would suggest, which leaves you a little play in other parameters.
- Frequency scale the filter
- Choose an implementation structure, such as passive, Sallen and Key active, state variable active.
- Choose component values,