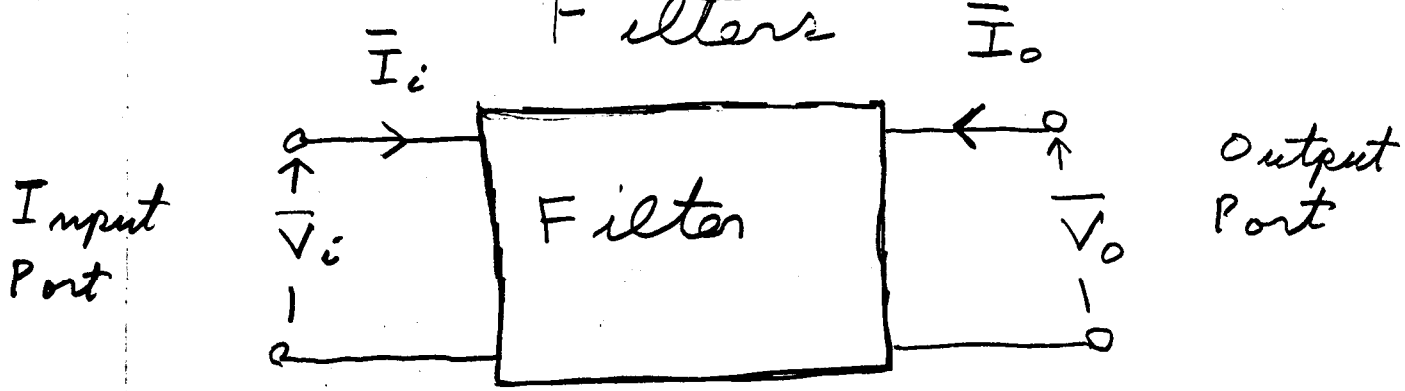
Filters



$$\bar{T} = \left.\frac{\bar{V}_o}{\bar{V}_i}\right|_{\bar{I}_o = 0} \equiv \text{complex transfer function}$$

$$\bar{Z}_i = \left.\frac{\bar{V}_i}{\bar{I}_i}\right|_{\bar{I}_o = 0} = \text{input impedance}$$

$$\bar{Z}_o = \left.\frac{\bar{V}_o}{\bar{I}_o}\right|_{\bar{V}_i = 0} = \text{output impedance}$$

$$\bar{T} = K \frac{(s - z_1)(s - z_2) \cdots (s - z_m)}{(s - p_1)(s - p_2) \cdots (s - p_N)}$$

z_i zeroes

p_i poles

N order of filter

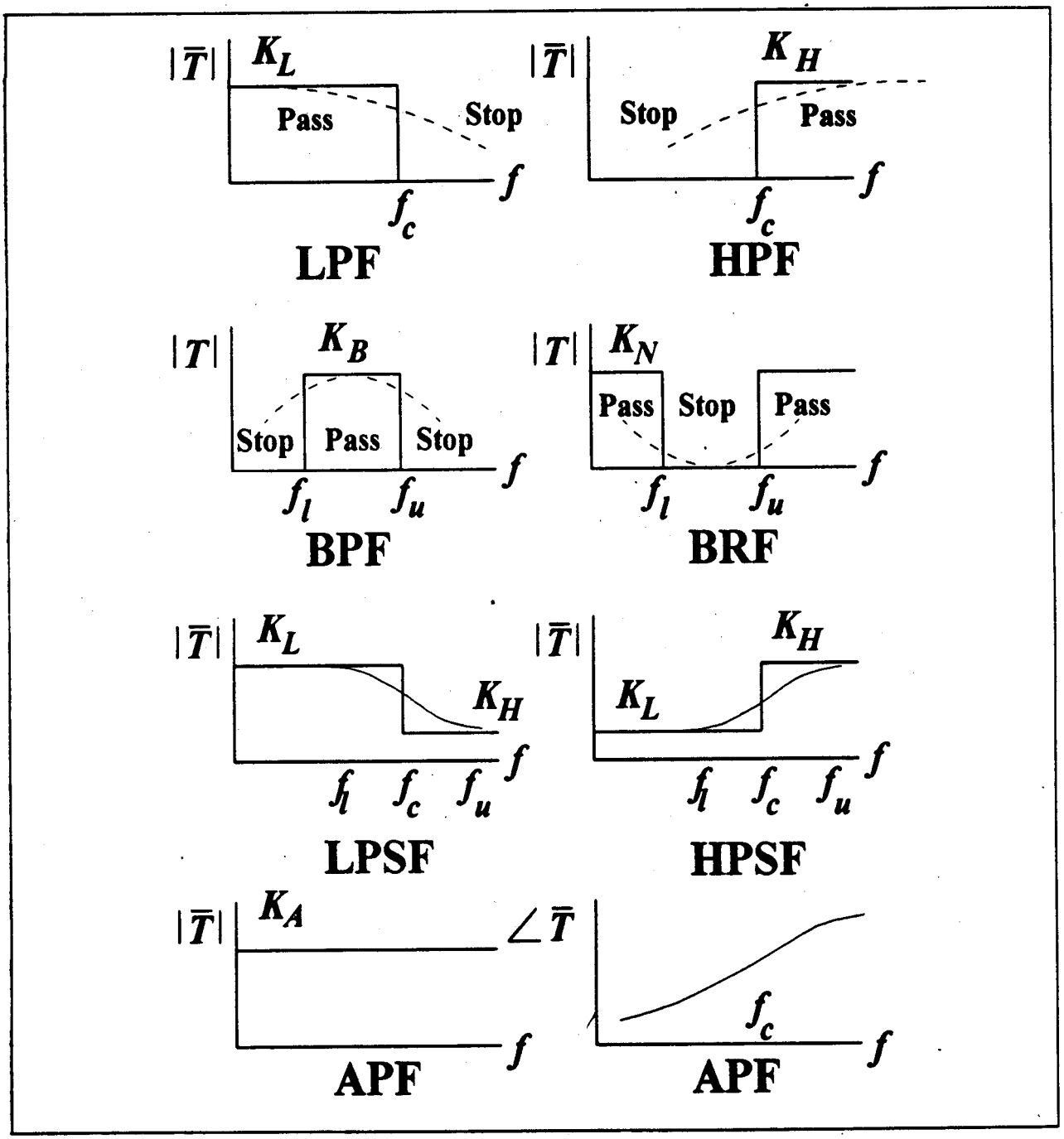
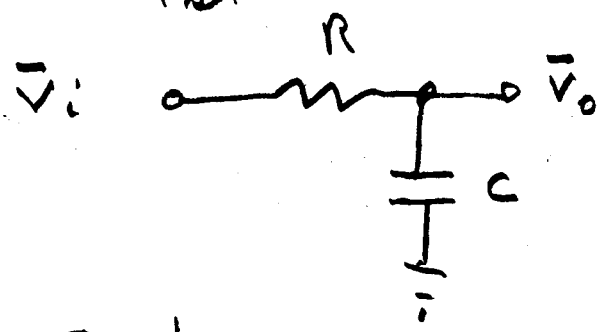


Figure 5-2 Filter Types

Unity DC Gain LPF

1st

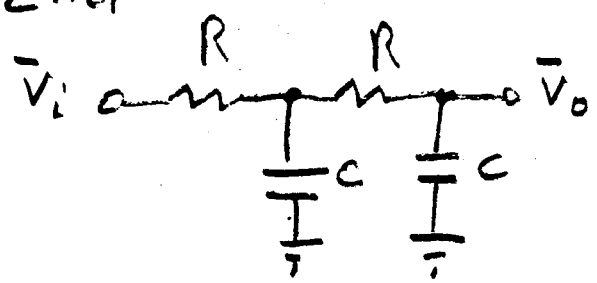


$$\bar{T} = \frac{1}{1+\Omega\tau}$$

$$f_{-3dB} = \frac{1}{2\pi\tau}$$

$$\tau = RC$$

2nd

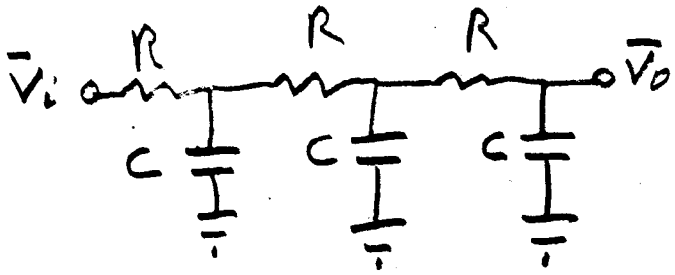


$$\bar{T} = \frac{1}{\Omega^2\tau^2 + 3\Omega\tau + 1}$$

$$f_{-3dB} = \frac{0.374}{2\pi\tau}$$

$$\tau = RC$$

3rd

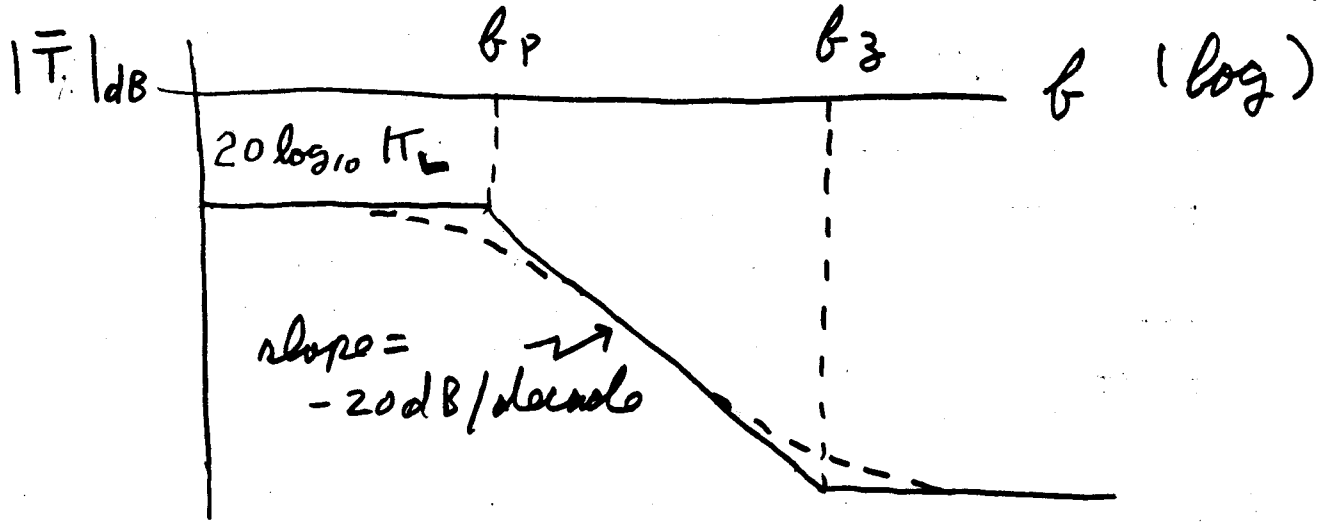


$$f_{-3dB} = \frac{0.194}{2\pi\tau}$$

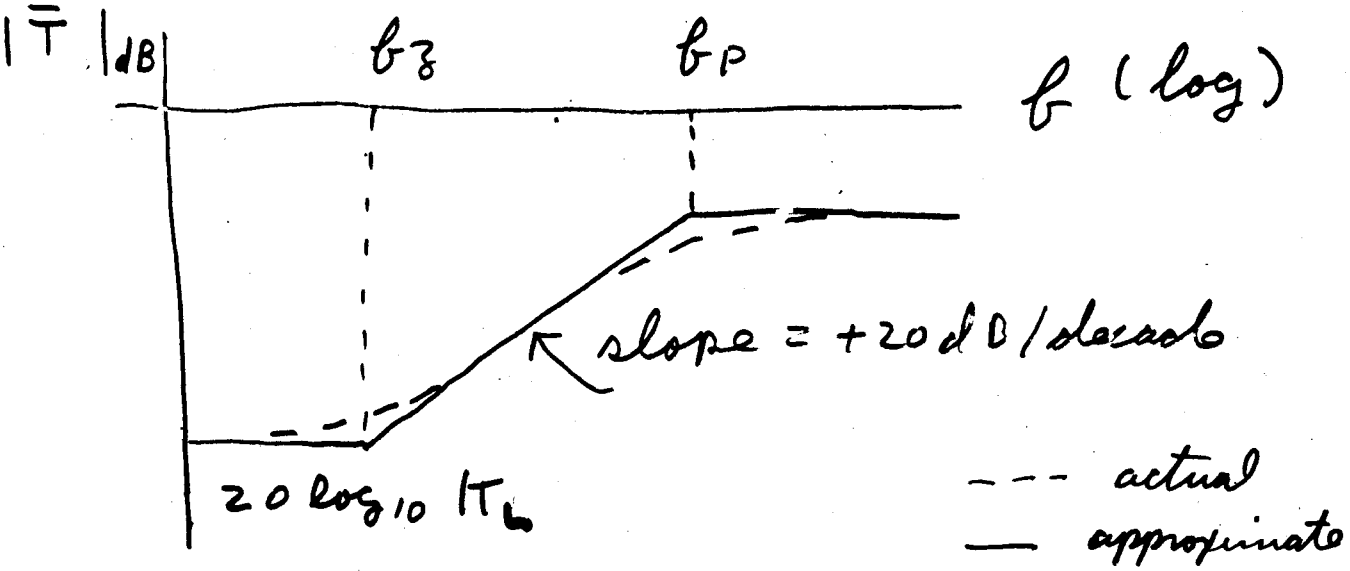
$$\tau = RC$$

$$\bar{T} = \frac{1}{\Omega^3\tau^3 + 5\Omega^2\tau^2 + 6\Omega\tau + 1}$$

if $f_p < f_z$, $f_p = \frac{1}{2\pi\tau_p}$, $f_z = \frac{1}{2\pi\tau_z}$



if $f_z < f_p$



$$T(\Delta) = |T_L| \frac{1 + \Delta\tau_z}{1 + \Delta\tau_p}$$