

Exercise 18:

Assignment 1 (Due Thursday June 12 2025)

1. Use Table 3.1 to write the transfer functions $T(s)$ for *highpass*, *bandpass*, *bandstop*, and *allpass* responses. **(4 marks)**
2. For each of the transfer functions, obtain expressions for the magnitude response $|T(\omega)|$ and the phase response $\theta(\omega)$. **(8 marks)**
3. Estimate $|T(\omega)|$ and $\theta(\omega)$ for each of the responses at low frequencies ($\omega = 0$), corner frequency ($\omega = \omega_0$), and high frequencies ($\omega = \infty$). **(8 marks)**
4. For each transfer function, sketch the magnitude and phase responses by hand. **(8 marks)**
5. Write scripts in MATLAB or Python to plot the magnitude and phase responses for each transfer function using two values of Q: 1 and 10. The magnitude axis should be in dB and use the log scale for the frequency axis. You can use a convenient substitution for ω_0 , such as $\omega_0 = 1$ rad/s. What observations can you make about the slopes of the high frequency and low frequency asymptotes of the $|T(\omega)|$ plots? **(20 marks)**
6. Sketch passive $R-L-C$ circuits that you can use to realize each of the transfer functions and provide select values for circuit components that would give $Q = 10$ and $\omega_0 = 10000\pi$ rad/s. **(12 marks)**

Solution 18:

Your assignment solutions.