ENGR 3323: Signals and Systems

HW 7_Ch4

Q1) Realize the systems below by canonic direct, series, and parallel forms.

a) $H(s) = \frac{s(s+2)}{(s+1)(s+3)(s+4)}$ b) $H(s) = \frac{s^3}{(s+1)(s^2+4s+13)}$

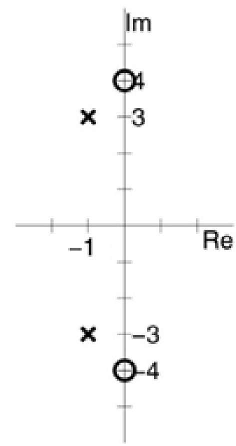
Q2) Show an op-amp canonic direct realization of the transfer function

$$H(s) = \frac{3s+7}{s^2+4s+10}$$

Q3) Using the graphical method of Section 4.10-1, draw a rough sketch of the amplitude and phase response of an LTIC system described by the transfer function

$$H(s) = \frac{s^2-2s+50}{s^2+2s+50} = \frac{(s-1-j7)(s-1+j7)}{(s+1-j7)(s+1+j7)}$$ What kind of filter is this?

Q4) The pole-zero plot of a second-order system *H*(*s*) is shown in Figure below. The dc response of this system is minus 2, *H*(*j*0) = -2



a) Letting $H(s) = k\frac{s^2+b_1s+b_2}{s^2+a_1s+a_2}$, determine the constants k, b_1, b_2, a_1, a_2.
b) Using the graphical method of Sec. 4.10-1, hand-sketch the magnitude response $|H(j\omega)|$ over $-10 \le \omega \le 10$.
c) Using the graphical method of Sec. 4.10-1, hand-sketch the phase response $\angle H(j\omega)$ over $-10 \le \omega \le 10$.
d) What is the output $y(t)$ in response to input $x(t) = -3+\cos(3t+\pi/3) - \sin(4t- \pi/8)$

Q5) Design a second-order bandpass filter with center frequency $\omega = 10$. The gain should be zero at $\omega = 0$ and at $\omega = \infty$. Select poles at $-a \pm j10$. Leave your answer in terms of a. Explain the influence of a on the frequency response.

Q6) In communication channels, transmitted signal is propagated simultaneously by several paths of varying lengths. This causes the signal to reach the destination with varying time delays and varying gains. Such a system generally distorts the received signal. For error-free communication, it is necessary to undo this distortion as much as possible by using the system that is inverse of the channel model. For simplicity, let us assume that a signal is propagated by two paths whose time delays differ by τ seconds. The channel over the intended path has a delay of T seconds and unity gain. The signal over the unintended path has a delay of $T + \tau$ seconds and gain a. Such a channel can be modeled, as shown in Figure below. Find the inverse system transfer function to correct the delay distortion and show that the inverse system can be realized by a feedback system. The inverse system should be causal to be realizable. [Hint: We want to correct only the distortion caused by the relative delay τ seconds. For distortionless transmission, the signal may be delayed. What is important is to maintain the shape of $x(t)$. Thus a received signal of the form $cx(t - T)$ is considered to be distortionless.]