

ECE 321 - Quiz #3 - Name _____

Filters. Fall 2019

1) X and Y are related by the following transfer function

$$Y = \left(\frac{100(s+2)}{(s+4)(s+5)} \right) X = \left(\frac{100s+200}{s^2+9s+20} \right) X$$

What is the differential equation relating X and Y?

Find y(t) assuming

$$x(t) = 6 + 7 \sin(8t)$$

2) The transfer function for a 4th-order Butterworth filter with a DC gain of 1.00 and a corner at 1 rad/sec is

$$G(s) = \left(\frac{1}{(s+1\angle 22.5^\circ)(s+1\angle -22.5^\circ)(s+1\angle 67.5^\circ)(s+1\angle -67.5^\circ)} \right) = \left(\frac{1}{(s+1\angle \pm 22.5^\circ)(s+1\angle \pm 67.5^\circ)} \right)$$

What is the transfer function for a 4th-order Butterworth filter with a DC gain of 1.00 and a corner at 100 rad/sec?

The transfer function for a 4th-order Chebychev filter with a DC gain of 1.00 and a corner at 1 rad/sec is

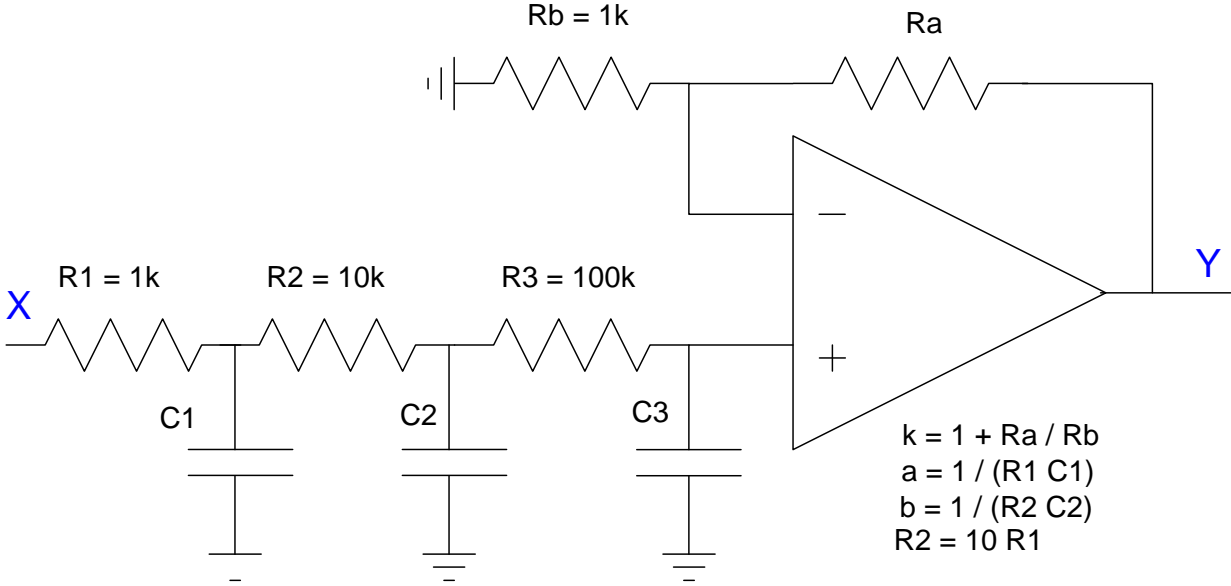
$$G(s) = \left(\frac{0.6387}{(s+0.72\angle \pm 38.5^\circ)(s+1.11\angle \pm 77.8^\circ)} \right)$$

What is the transfer function for a 4th-order Chebychev filter with a DC gain of 1.00 and a corner at 100 rad/sec?

3) Find R and C to implement the following transfer function with real poles

$$Y = \left(\frac{200}{(s+2)(s+5)(s+10)} \right) X$$

C1	C2	C3	Ra

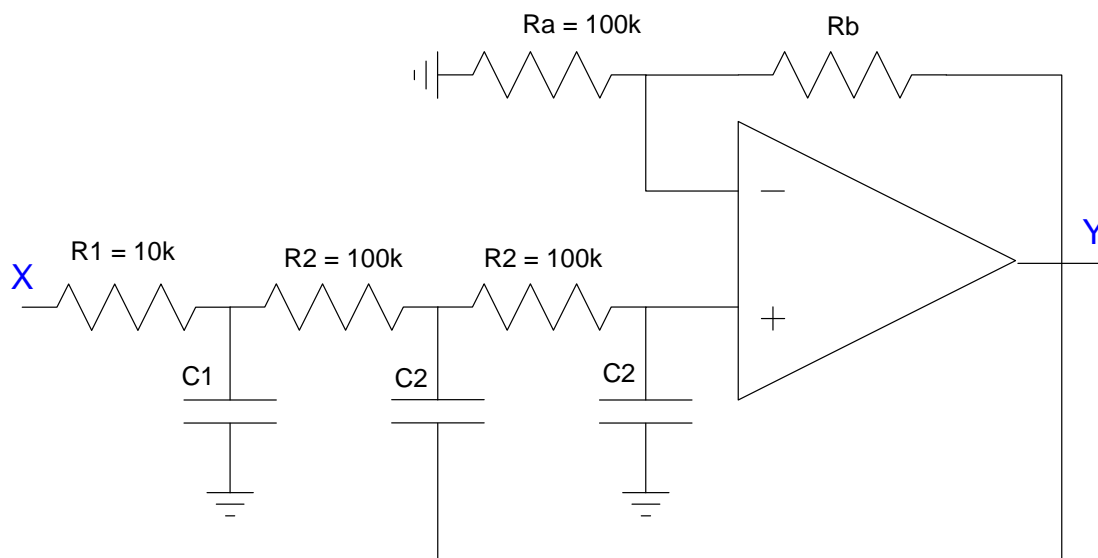


$$G(s) \approx \left(\frac{k \cdot abc}{(s+a)(s+b)(s+c)} \right)$$

4) Determining R and C to implement the following filter

$$Y = \left(\frac{1,244,000}{(s+85)(s+121 \angle \pm 69.5^\circ)} \right) X$$

C1	C2	Rb	resulting DC gain

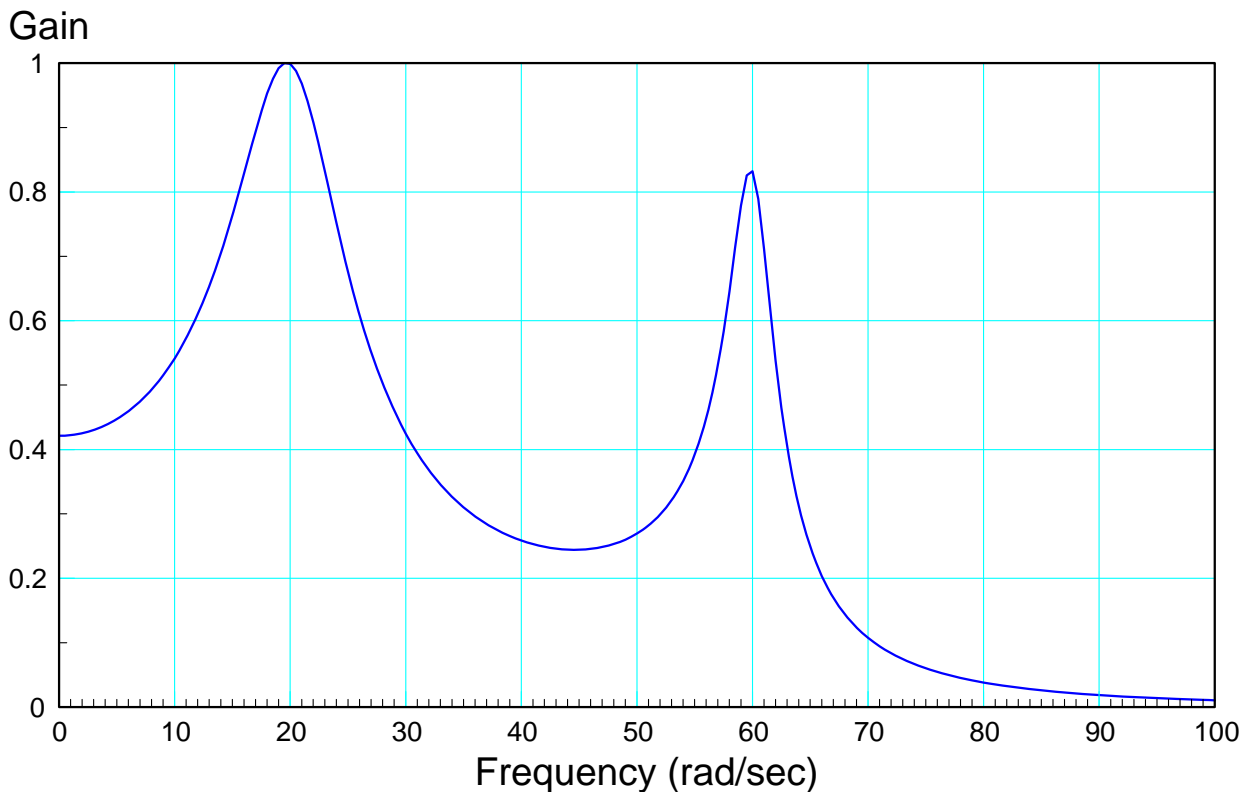


$$Y = \left(\frac{\left(\frac{1}{R_1 C_1} \right)}{s + \left(\frac{1}{R_1 C_1} \right)} \right) \left(\frac{k \left(\frac{1}{R_2 C_2} \right)^2}{s^2 + \left(\frac{3-k}{RC} \right) s + \left(\frac{1}{RC} \right)^2} \right) X \quad k = 1 + \frac{R_b}{R_a}$$

5) A 4th-order filter has the following gain vs. frequency. Determine the location of the poles (real and complex part)

$$Y = \left(\frac{k}{(s+p_1)(s+p_1^*)(s+p_2)(s+p_2^*)} \right) X$$

Pole #1		Pole #2	
real part	complex part	real part	complex part



Phinneas and Ferb Bonus! What was the purpose of the Tree-Falls-In-The-Woods-Inator?

- Knock down all of the trees in the Tri-State area so Dr. Doofenschmirtz's kites won't get stuck anymore
- Make it so that anything that falls makes the sound "Doofenschmirtz"
- Get rid of the trees that are blocking Dr. Doofenschmirtz's view of the ocean
- Create a wind-storm so the ceremony for Dr. Doofenschmirtz's brother has to be cancelled