ECE 321 - Quiz #4 - Name _____

Filters, Filter Design, Analog Computers. Due midnight, March 29th

1) X and Y are related by

$$Y = \frac{20s+30}{(s+M)(s+D)} X$$

where

- M is your birth month (1..12), and
- D is your birth date (1..31)

Determine y(t) assuming

$$x(t) = 3 + 4\sin(5t)$$

2) Design an op-amp circuit (a.k.a. an analog computer) to implement

$$Y = \frac{20s+30}{(s+M)(s+D)} X$$

where

- M is your birth month (1..12), and
- D is your birth date (1..31)

3) The transfer function for a 6th-order Chebychev filter with a corner at 1 rad/sec is

$$G(s) = \frac{0.1593}{s+0.4722\angle\pm 36.10^{0} \quad s+0.8100\angle\pm 69.83^{0} \quad s+1.0436\angle\pm 84.38^{0}}$$

Give the transfer function for a 6th-order Chebychev filter with

- A DC gain of 1.000 and
- A corner at X rad/sec

where

- X = 1000 + 100*(your birth month) + (your birth date)

4) Give the transfer function for a 7th-order Butterworth filter with

- A DC gain of 1.000 and
- A corner at X rad/sec

where

- X = 1000 + 100*(your birth month) + (your birth date)

5) Specify a filter to meet the following requirements:

- $0.9 < \text{gain} < 1.1$ $\quad 0 < w < 300$ rad/sec
- $\text{gain} < 0.1$ $\quad w > 450$ rad/sec

5a) How many poles does the filter need?

5b) Give the transfer function of a filter, G(s), which meets these requirements

5c) What is the gain of your filter at 300 and 450 rad/sec?

# poles needed	G(s)	Gain at 300 rad/sec	Gain at 450 rad/sec

6) The difference between a square wave and a sine wave is a square wave has a 3rd harmonic. Design a filter to remove the 3rd harmonic (make it 30x smaller in amplitude than the 1st harmonic)

- $0.9 < \text{gain} < 1.1$ $0 < w < 200$ rad/sec
- $\text{gain} < 0.1$ $w > 300$ rad/sec

6a) How many poles does the filter need?

6b) Give the transfer function of a filter, G(s), which meets these requirements

6c) What is the gain of your filter at 200 and 300 rad/sec?

# poles needed	G(s)	Gain at 200 rad/sec	Gain at 300 rad/sec