

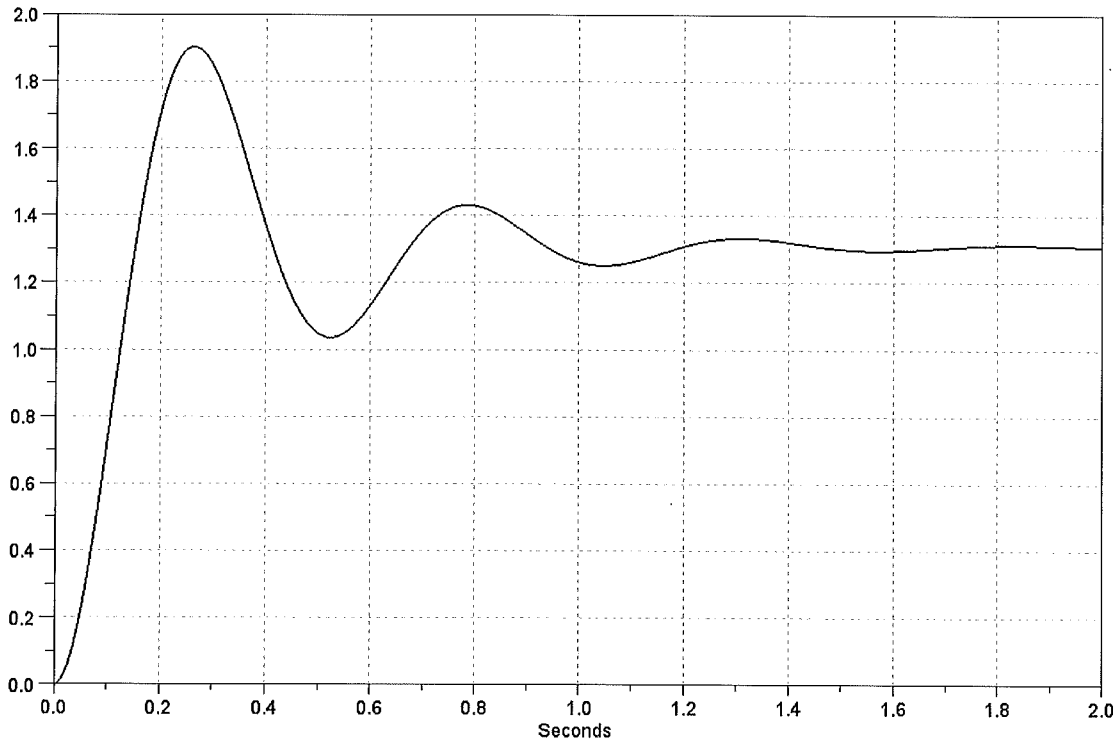
ECE 461 - Test #2: Name _____

Modeling, Dynamics, Root Locus - October 20, 2017

1) Find the transfer function for the system which has the following step response:

$$G(s) = \frac{200}{(s+3+j12)(s+3-j12)}$$

↑ exact: I'd bet generated this graph



$$DC = 1.3$$

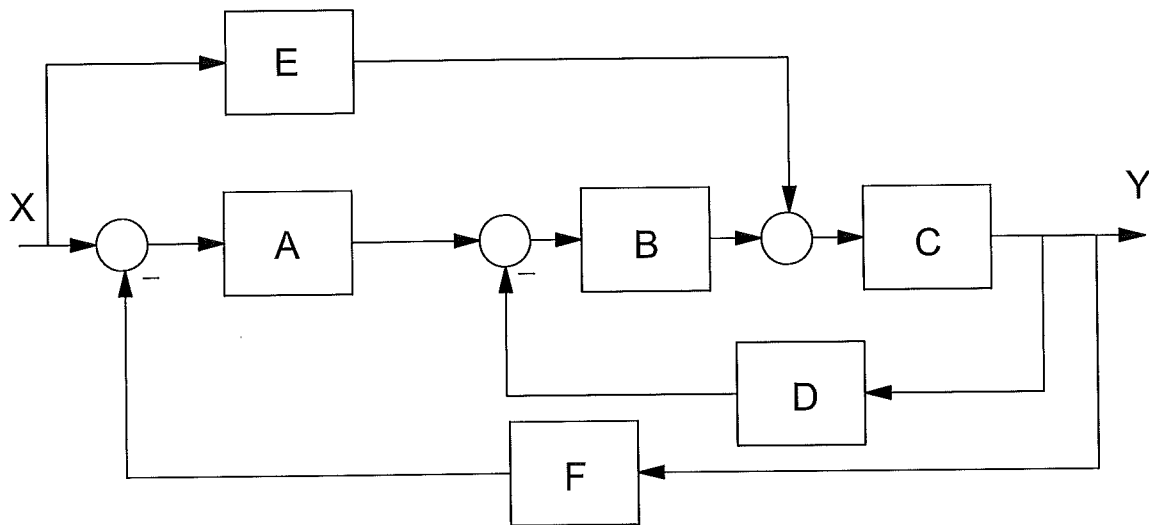
$$\omega_d = \left(\frac{2 \text{ cycles}}{1.05 \text{ sec}} \right) 2\pi = 11.97 \text{ rad/sec}$$

$$T_s = 1.4 \text{ sec} \quad \sigma = \frac{4}{1.4} = 2.86$$

$$G(s) \approx \frac{1.3 (2.86^2 + 11.97^2)}{(s+2.86+j11.97)(s+2.86-j11.97)}$$

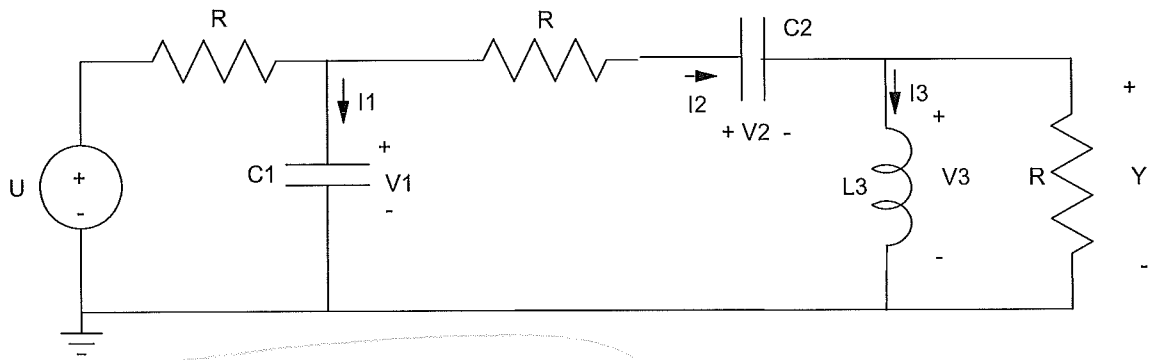
2) Determine the transfer function from X to Y for the following block diagram

ans =



$$\frac{ABC + EC}{1 + BCD + ABCF}$$

3) Write the differential equations which describe the dynamics for the following RLC circuit



$$I_1 = C_1 \dot{V}_1$$

$$I_2 = C_2 \dot{V}_2$$

$$V_3 = L_3 \dot{I}_3$$

$$C_1 \dot{V}_1 = \frac{U - V_1}{R} - I_2$$

$$C_2 \dot{V}_2 = I_3 + \frac{V_3}{R}$$

$$L_3 \dot{I}_3 = V_1 - V_2 - I_2 R$$

-or- putting together

$$C_1 \dot{V}_1 = \frac{U - V_1}{R} - C_2 \dot{V}_2$$

$$C_2 \dot{V}_2 = I_3 + \frac{L_3 \dot{I}_3}{R}$$

$$L_3 \dot{I}_3 = V_1 - V_2 - \frac{(C_2 \dot{V}_2) R}{1}$$

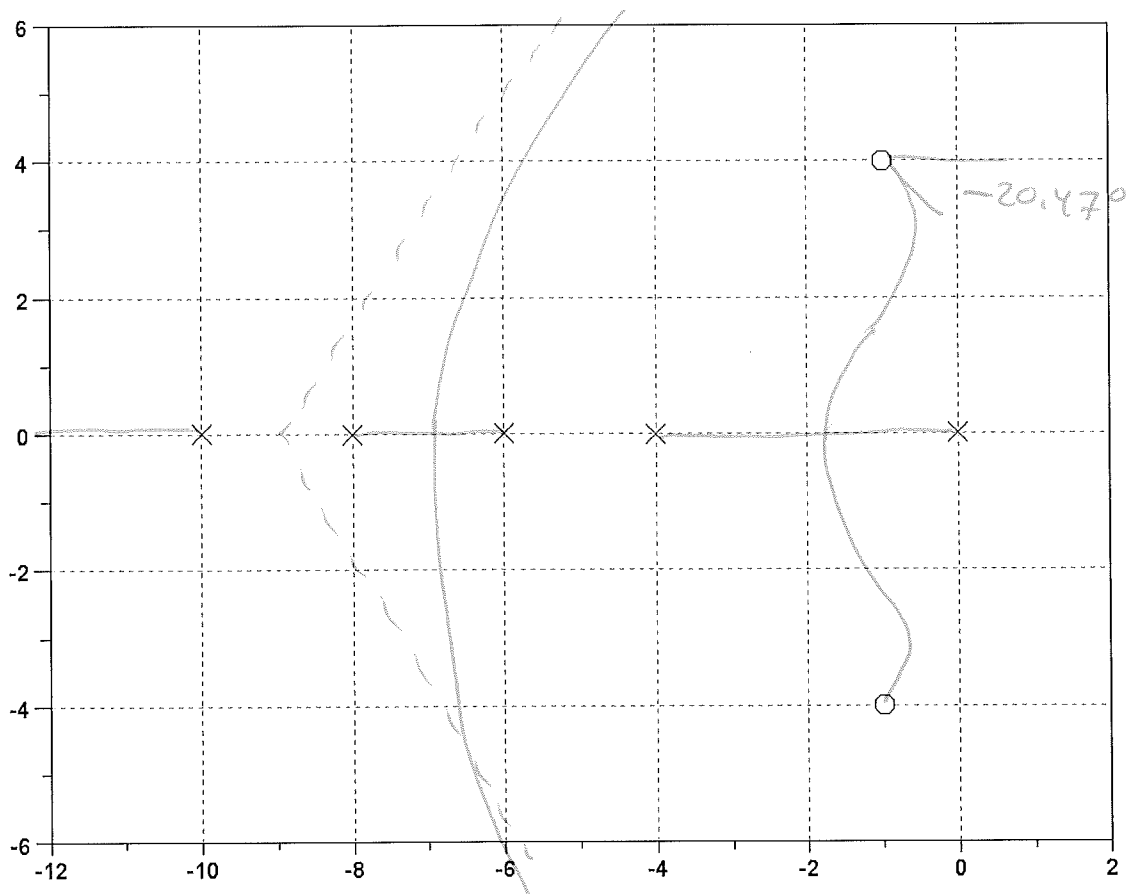
4) Error Constants: Determine the system type, the error constant K_p , and the closed-loop steady-state error for a step input for the following open-loop systems:

Open Loop System $G(s)$	System Type	Error Constant K_p	Steady-State Error for a Step Input
$\left(\frac{100}{(s+2)(s+4)}\right)$	0	12.5	.0741
$\left(\frac{100}{(s-2)(s+4)}\right)$	0	-12.5	-0.0870
$\left(\frac{100}{s(s+2)(s+4)}\right)$	1	∞ or DNE	0

5) Sketch the root locus for $G(s)$ on the following graph. What are the following?

$$G(s) = \left(\frac{(s+1+j4)(s+1-j4)}{s(s+4)(s+6)(s+8)(s+10)} \right)$$

Real Axis Loci	$(0, -4)$ $(-6, -8)$ $(-10, -\infty)$
Breakaway Point (approx)	-6.8 -7
$j\omega$ Crossing (approx)	$\approx j15$ (asymptote intersect of $j\omega$ axis)
Approach Angle to the zero at $-1 + j4$	-20.47°
# Asymptotes	3
Asymptote Intersect	-8.67



Bonus! How much does a used Nissan Leaf cost? (2014, 30k miles):

\$8000