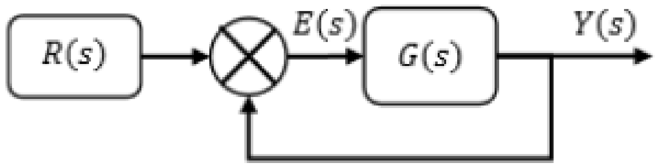
Assignment 1

- Problem 1



G(s) = $\frac{6}{(3s+0.12)(3s+0.06)}$

Solution

1. R(s) is unit step

R(s) = $\frac{1}{s}$

$$e_{ss} = \lim_{s\to 0} s \frac{R(s)}{1 + G(s)H(s)}$$

$$e_{ss} = \lim_{s\to 0} s \frac{\frac{1}{s}}{1 + \frac{6}{(3s+0.12)(3s+0.06)}}$$

$$e_{ss} = \frac{1}{1 + \frac{6}{(0+0.12)(0+0.06)}} = \frac{3}{2503} = 1.1985 * 10^{-3}$$

2. R(s) is ramp input

R(s) = $\frac{1}{s^2}$

$$e_{ss} = \lim_{s\to 0} s \frac{R(s)}{1 + G(s)H(s)}$$

$$e_{ss} = \lim_{s\to 0} s \frac{\frac{1}{s^2}}{1 + \frac{6}{(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \lim_{s\to 0} \frac{\frac{1}{s}}{1 + \frac{6}{(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \frac{1}{0 + \frac{0}{(0 + 0.12)(0 + 0.06)}} = \frac{1}{0} = \infty$$

3. R(s) is parabolic input

$$e_{ss} = \lim_{s\to 0} s \frac{R(s)}{1 + G(s)H(s)}$$

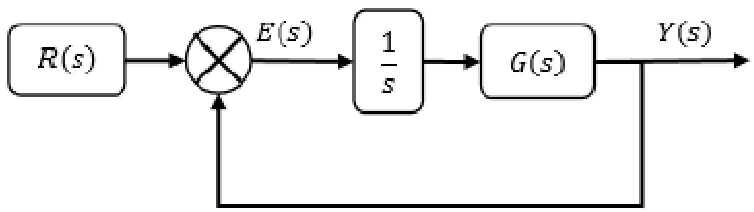
$$e_{ss} = \lim_{s\to 0} s \frac{\frac{1}{s^3}}{1 + \frac{6}{(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \lim_{s\to 0} \frac{\frac{1}{s^2}}{1 + \frac{6}{(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \frac{1}{1s^2 + \frac{6s^2}{(0 + 0.12)(0 + 0.06)}}$$

$$e_{ss} = \frac{1}{0 + \frac{0}{(0 + 0.12)(0 + 0.06)}} = \frac{1}{0} = \infty$$

- Problem 2



1. R(s) is unit step

$$e_{ss} = \lim_{s\to 0} s\frac{R(s)}{1+G(s)H(s)}$$

$$e_{ss} = \lim_{s\to 0} s\frac{\frac{1}{s}}{1+\frac{6}{s(3s+0.12)(3s+0.06)}}$$

$$e_{ss} = \frac{1}{1+\frac{6}{0*(0+0.12)(0+0.06)}} = \frac{1}{1+\frac{6}{0}} = \frac{1}{1+\infty} = 0$$

2. R(s) is a ramp input

$$e_{ss} = \lim_{s\to 0} s \frac{R(s)}{1 + G(s)H(s)}$$

$$e_{ss} = \lim_{s\to 0} s \frac{\frac{1}{s^2}}{1 + \frac{6}{s(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \lim_{s\to 0} \frac{\frac{1}{s}}{1 + \frac{6}{s(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \lim_{s\to 0} \frac{1}{1s + \frac{6s}{s(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \frac{1}{0 + \frac{6}{(0 + 0.12)(0 + 0.06)}} = \frac{3}{2500} = 1.2 * 10^{-3}$$

3. R(s) is parabolic input

$$e_{ss} = \lim_{s\to 0} s \frac{R(s)}{1 + G(s)H(s)}$$

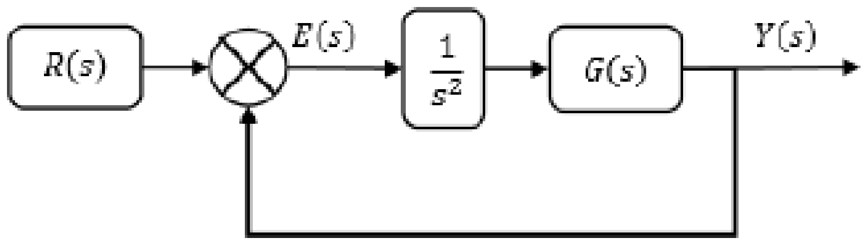
$$e_{ss} = \lim_{s\to 0} s \frac{\frac{1}{s^3}}{1 + \frac{6}{(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \lim_{s\to 0} \frac{\frac{1}{s^2}}{1s^2 + \frac{6s^2}{s(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \frac{1}{1s^2 + \frac{6s}{(0 + 0.12)(0 + 0.06)}}$$

$$e_{ss} = \frac{1}{0 + \frac{0}{(0 + 0.12)(0 + 0.06)}} = \frac{1}{0} = \infty$$

- Problem 3



1. R(s) is unit step

$$e_{ss} = \lim_{s \to 0} s \frac{R(s)}{1 + G(s)H(s)}$$

$$e_{ss} = \lim_{s \to 0} s \frac{\frac{1}{s}}{1 + \frac{6}{s^2(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \frac{1}{1 + \frac{6}{0 * (0 + 0.12)(0 + 0.06)}} = \frac{1}{1 + \frac{6}{0}} = \frac{1}{1 + \infty} = 0$$

2. R(s) is ramp input

$$e_{ss} = \lim_{s \to 0} s \frac{R(s)}{1 + G(s)H(s)}$$

$$e_{ss} = \lim_{s \to 0} s \frac{\frac{1}{s^2}}{1 + \frac{6}{s^2(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \lim_{s \to 0} \frac{\frac{1}{s}}{1 + \frac{6}{s^2(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \lim_{s \to 0} \frac{1}{1s + \frac{6s}{s^2(3s + 0.12)(3s + 0.06)}}$$

$$e_{ss} = \frac{1}{0 + \frac{6}{0 * (0 + 0.12)(0 + 0.06)}} = \frac{3}{\frac{6}{0}} = \frac{3}{\infty} = 0$$

3. R(s) is parabolic input

$$e_{ss} = \lim_{s\to 0} s \frac{R(s)}{1 + G(s)H(s)}$$

$$e_{ss} = \lim_{s\to 0} s \frac{\frac{1}{s^3}}{1 + \frac{6}{s^2(3s+0.12)(3s+0.06)}}$$

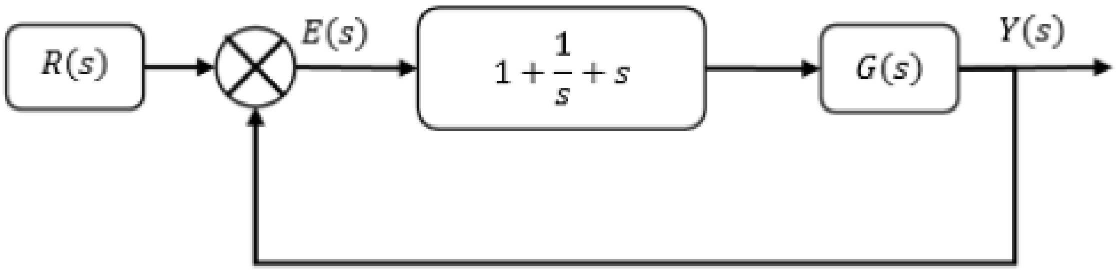
$$e_{ss} = \lim_{s\to 0} \frac{\frac{1}{s^2}}{1s^2 + \frac{6s^2}{s^2(3s+0.12)(3s+0.06)}}$$

$$e_{ss} = \frac{1}{1s^2 + \frac{6}{(0+0.12)(0+0.06)}}$$

$$e_{ss} = \frac{1}{0 + \frac{6}{(0+0.12)(0+0.06)}} = \frac{3}{2500} = 1.2 * 10^{-3}$$

R(s)	G(s)	$\frac{G(s)}{s}$	$\frac{G(s)}{s^2}$
$\frac{1}{s}$	1.1985*10^{-3}	0	0
$\frac{1}{s^2}$	∞	1.2*10^{-3}	0
$\frac{1}{s^3}$	∞	∞	1.2*10^{-3}

- Problem 4



1.. G(s) = $\frac{5}{s^2+7s+10}$

$$e_{ss} = \lim_{s\to 0} s \frac{\frac{1}{s}}{1 + \frac{5}{s^2+7s+10} * \left(1 + \frac{1}{s} + \mathrm{s}\right)}$$

$$e_{ss} = \lim_{s\to 0} \frac{1}{1 + \frac{5}{0+0+10} * \left(1 + \frac{1}{0} + 0\right)} = \frac{1}{\infty} = 0$$

2. G(s) = $\frac{10}{0.3s+1}$

$$e_{ss} = \lim_{s\to 0} s \frac{\frac{1}{s}}{1 + \frac{10}{0.3s+1} * \left(1 + \frac{1}{s} + \mathrm{s}\right)}$$

$$e_{ss} = \lim_{s\to 0} \frac{1}{1 + \frac{10}{0+1} * \left(1 + \frac{1}{0} + 0\right)} = \frac{1}{\infty} = 0$$

- Problem 5

$= \frac{2s-8}{(s-3)(s-2)} = \frac{A}{s-3} + \frac{B}{s-2}$

$$2s - 8 = A(s-2) + B(s-3)$$

At s = 2

-4 = 0 + -B $\longrightarrow$ B = 4

At s = 3

A = -2

$$Y(s) = l^{-1}\ \frac{-2}{s-3} + l^{-1}\ \frac{4}{s-2}$$

$$Y(t) = -2e^{3t} - 4e^{2t}$$

2.. $\frac{Y(s)}{R(s)} = \frac{2s-8}{s^2-5s+6}$, R(s) = $\frac{1}{s}$

$= \frac{2s-8}{s(s-3)(s-2)} = \frac{A}{s-3} + \frac{B}{s-2} + \frac{C}{s}$

2s−8 $= A(s-2) + B(s-3) + C(s-3)(s-2)$

At s=2

0-2B+0=-4 B=2

At s=3

3A-0+0=-2 A=-23

1.. $\frac{Y(s)}{R(s)} = \frac{2s-8}{s^2-5s+6}$

At s=0

0+0+6C=-8 C=-43

$$Y(s) = l^{-1}\frac{\frac{-2}{3}}{s-3} + l^{-1}\frac{2}{s-2} + l^{-1}\frac{\frac{-4}{3}}{s}$$

$$Y(t) = -\frac{2}{3}e^{3t} + 2e^{2t} - \frac{4}{3}$$

3.. $\frac{Y(s)}{R(s)} = \frac{2s-8}{s^2-5s+6}$, R(s) = $\frac{1}{s^2}$

= $\frac{2s-8}{s^2(s-3)(s-2)} = \frac{A}{s-3} + \frac{B}{s-2} + \frac{C}{s} + \frac{D}{s^2}$

A(s-2) s2+B(s-3) s2+C (s-2)(s-3)s+ D (s-2)(s-3)=2s-8

At s=2

-4B=-4 B=1

AT s=3

9A=-2 A=−29

At s=0

6D=-8 D=−43

At s=1

−29 (1-2) 12+ (1-3) 12+C (1-2)(1-3)1+ −43 (1-2)(1-3)=2*1-8

=29−2+2C+−83=−6

2C+−409=−6

2C= 949   C= 479

$$Y(s) = l^{-1}\,\frac{\frac{-2}{9}}{s-3} + l^{-1}\,\frac{1}{s-2} + l^{-1}\,\frac{\frac{47}{9}}{s} + l^{-1}\,\frac{\frac{-4}{3}}{s^2}$$

$$Y(t) = -\frac{2}{9}e^{3t} + e^{2} + \frac{47}{9} + \frac{-4}{3}t$$

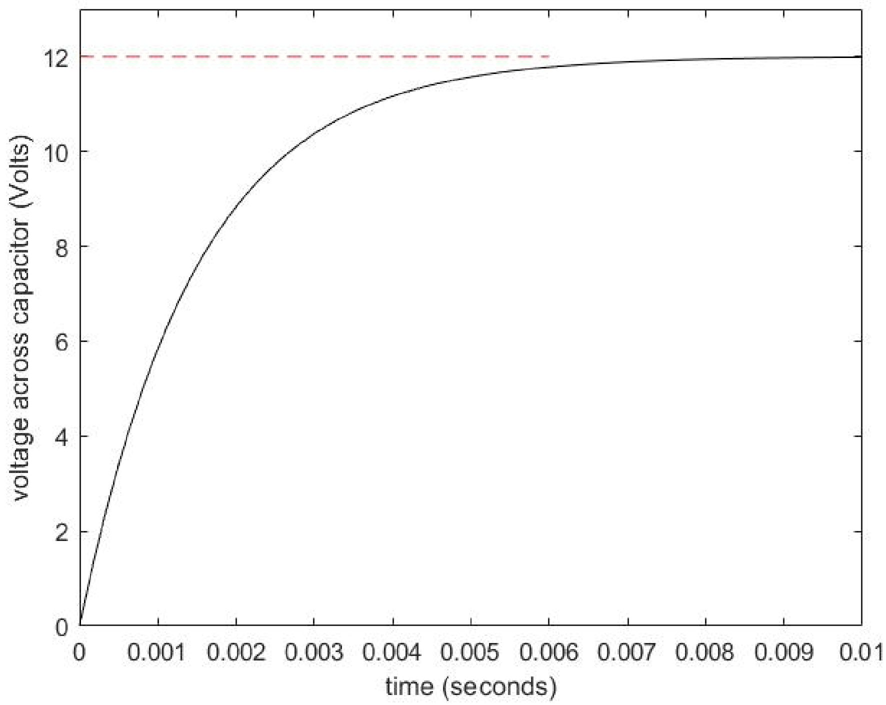
- Problem 6

Model the RC circuit as a function of time in the form:

$$\boldsymbol{v_c(t)} = \boldsymbol{f}(v_s(t), R, C, v_c(t-\Delta t))$$

Where:

$v_s(t)$ ... *source voltage*
R ... *resistence in ohms*
C ... *capacitance in farad*
Δt ... *stepping time*



Note

Dear, Eng Waleed El-badry

I need to notice that , I sent Assignment 2 yesterday at 9:43 pm but I was have a problem on github desktop to make invite to you . and I commit to master that I think that you the master and the Ass sent to you . when I reviewed it today on github website I found that you didn’t seen the repository and I made invite to you .

Please , see my Assignment , and sorry for this mistake.

Thank you .

Omar Ashraf

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