

PROJECT 02

ECE 317

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1 Overview

The purpose of this lab is to do a thing.

2 Calculations

2.1 PECS Simulation

Calculations from Tasks 5 - 8:

$$\begin{aligned} c_{max} &= 5.93085 \text{ V} - 5 \text{ V} \\ c_{max} &= 0.93085 \text{ V} \end{aligned} \tag{1}$$

$$\begin{aligned} c_{final} &= 5.5 \text{ V} - 5 \text{ V} \\ c_{final} &= 0.5 \text{ V} \end{aligned} \tag{2}$$

$$\%OS = \frac{0.93085 \text{ V} - 0.5 \text{ V}}{0.5 \text{ V}} \cdot 100$$

$$\%OS = 86.17\%$$

$$\zeta = \frac{-\ln(86.17/100)}{\sqrt{\pi^2 + \ln^2(86.17/100)}}$$

$$\zeta = 0.047327$$

$$0.5 \text{ V} * 0.02 = 0.01 \text{ V}$$

$$c_{final} \pm 2\% = 0.5 \text{ V} \pm 0.01 \text{ V}$$

$$c'_{final} \pm 2\% = 5.501 \text{ V and } 5.499 \text{ V}$$

$$T_s = 0.140627 \text{ s} - 0.11 \text{ s}$$

$$T_s = 0.030627 \text{ s}$$

$$\omega_n = \frac{4}{0.047327 \cdot 0.030627}$$

$$\begin{aligned} \omega_n &= (\text{something}) \\ K &= \frac{5.5 \text{ V} - 5 \text{ V}}{5.5 \text{ V} - 5 \text{ V}} \end{aligned}$$

$$K = 1$$

2.2 MATLAB

Derivation of Transfer Function, symbolically:

$$Z_{RC} = (1/R + Cs)^{-1}$$

$$Z_{RC} = \frac{R}{sRC+1}$$

$$Z_{EQ} = Ls + Z_{RC}$$

$$Z_{EQ} = \frac{RLCs^2 + Ls + R}{RCs + 1}$$

$$V_{\text{out}} = V_{\text{in}} \cdot \frac{Z_{RC}}{Z_{EQ}}$$

$$\frac{V_{\text{out}}}{V_{\text{in}}} = \frac{R}{RLCs^2 + Ls + R}$$

$$G(s) = \frac{1}{LCs^2 + \frac{L}{R}s + 1}$$

So, we can see $a_1 = L/R$ and $a_2 = LC$.

$$\begin{aligned} a_1 &= \frac{560\mu}{25} \\ &= 22.4\mu \end{aligned}$$

and

$$\begin{aligned} a_2 &= 560\mu \cdot 100\mu \\ &= 56n \end{aligned}$$

To determine the values for K , ζ , and ω_n :

$$\begin{aligned} \omega_n &= \frac{1}{\sqrt{a_2}} \\ &= 4.2258 \frac{\text{rad}}{\text{sec}} \end{aligned}$$

3 Circuit 2

3.1 Circuit Diagram

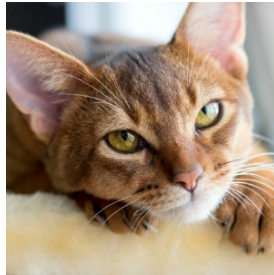


Figure 1: nyaaaaan

3.2 Analysis

Peak Amplitude	Period
2V	200 μ s

Table 1: Circuit 2 calculations

4 Questions

1. *How does it work?*

Black magic

5 MATLAB Code

```
1 % 317 things
2 % Kai Brooks
3 % github.com/kaibrooks
4 % 2019
5 %
6 % Do a thing
7
8 % Init
9 clc
10 close all
11 clear all
12 format
```

```
13 rng('shuffle')
14
15 L = 560e-6;
16 C = 100e-6;
17 R = 25;
18
19 % tf parameters k, a1, a2, as functions of L,C,R
20 K = 1;          % tf dc gain
21 a1 = 1;          % coefficient of s in denominator polynomial
22 a2 = 1;          % coefficient of s in denominator polynomial
23
24 tf_LCR = tf(K, [a2, a1, 1]); % tf of rlc network
25
26 % t is a vector of 100 time values linearly spaces between 0
    and 0.2
27 t = linspace(0, 0.2, 1000);
28 u = 5*ones(length(t), 1);
29 step_time = 0.11; % step the input at step_time
30 n = find(t >= step_time);
31 u(n) = u(n) + 0.5; % input containing 10% step at step_time
32
33 y = lsim(tf_LCR,u,t); % simulate the lcr network with the
    desired input
34
35 figure(1)
36 plot(t,y)
37 title('output response including the large-signal startup
    transient')
38
39 % isolate smal-signal step response
40 c_prime_0 = y(n(1)-1); % initial output before the step
41 ys = y(n) - c_prime_0; % small signal output response
42 ts = t(n) - step_time; % small signal response times
43
44 figure(2)
45 plot(ts, ys)
46 title('step response')
47
48 stepinfo(ys, ts) % obtain step response metrics
```