Project 02

ECE 317

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Contents

1 Overview

The purpose of this lab is to do a thing.

2 Calculations

2.1 PECS Simulation

Calculations from Tasks 5 - 8:

$$c_{max} = 5.930\,85\,\text{V} - 5\,\text{V}$$
$$c_{max} = 0.930\,85\,\text{V}$$

(1)

$$c_{final} = 5.5\,\text{V} - 5\,\text{V}$$
$$c_{final} = 0.5\,\text{V}$$

(2)

$$\%OS = \frac{0.930\,85\,\text{V} - 0.5\,\text{V}}{0.5\,\text{V}} \cdot 100$$

$$\%OS = 86.17\%$$

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

$$\zeta = 0.047327$$

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

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

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

$$T_s = 0.129\,419\,\text{s} - 0.11\,\text{s}$$

$$T_s = 0.019\,419\,\text{s}$$

$$\omega_n = \frac{4}{0.047327 \cdot 0.019419}$$

$$\omega_n = 4352.3\,\tfrac{\text{rad}}{\text{s}}$$
$$K = \frac{5.5\,\text{V} - 5\,\text{V}}{5.5\,\text{V} - 5\,\text{V}}$$

$$K = 1$$

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 $a_2 = LC$.

$$a_1 = \frac{560\mu}{25}$$

$$= 22.4\mu$$

and

$$a_2 = 560\mu \cdot 100\mu$$

$$= 56n$$

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

$$\omega_n = \frac{1}{\sqrt{a_2}}$$

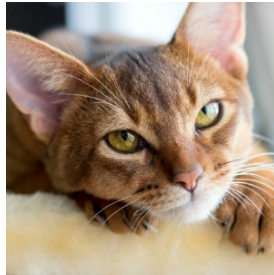$$= 4225.8 \tfrac{\text{rad}}{\text{sec}}$$

3 Circuit 2

3.1 Circuit Diagram

Figure 1: nyaaaaan

3.2 Analysis

Peak Amplitude	Period
2V	$200\mu s$

Table 1: Circuit 2 calculations

4 Questions

1. *How does it work?*

   Black magic

5 MATLAB Code

```matlab
% 317 things
% Kai Brooks
% github.com/kaibrooks
% 2019
%
% Do a thing

% Init
clc
close all
clear all
format
```

```matlab
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 = 22.4e-6;       % coeffecient of s in denominator
        polynomial
22  a2 = 56e-9;        % coeffecient 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); % inital 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
```