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:

$$\begin{aligned} c_{max} &= 5.930\,85\,\mathrm{V} - 5\,\mathrm{V} \\ c_{max} &= 0.930\,85\,\mathrm{V} \end{aligned} \tag{1}$$

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

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

$\%OS = 86.17\%$

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

$\zeta = 0.047327$

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

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

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

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

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

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

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

$K = 1$

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:

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

$= 4225.8 \, \frac{\text{rad}}{\text{sec}}$

3 Circuit 2

3.1 Circuit Diagram

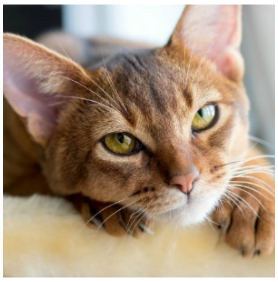

Figure 1: nyaaaaan

3.2 Analysis

Peak Amplitude	**Period**
2V	200μs

Table 1: Circuit 2 calculations

4 Questions

1. *How does it work?*

   Black magic

5 MATLAB Code

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

% Init
clc
close all
clear all
format
```

```
rng('shuffle')

L = 560e-6;
C = 100e-6;
R = 25;

% tf parameters k, a1, a2, as functions of L,C,R
K = 1;       % tf dc gain
a1 = 22.4e-6;      % coeffecient of s in denominator polynomial
a2 = 56e-9;     % coeffecient of s in denominator polynomial

tf_LCR = tf(K, [a2, a1, 1]); % tf of rlc network

% t is a vector of 100 time values linearly spaces between 0 and 0.2
t = linspace(0, 0.2, 1000);
u = 5*ones(length(t), 1);
step_time = 0.11; % step the input at step_time
n = find(t >= step_time);
u(n) = u(n) + 0.5; % input containing 10% step at step_time

y = lsim(tf_LCR,u,t); % simulate the lcr network with the desired input

figure(1)
plot(t,y)
title('output response including the large-signal startup transient')

% isolate smal-signal step response
c_prime_0 = y(n(1)-1); % inital output before the step
ys = y(n) - c_prime_0; % small signal output response
ts = t(n) - step_time; % small signal response times

figure(2)
plot(ts, ys)
title('step response')

stepinfo(ys, ts) % obtain step response metrics
```