Johnson Le

CMPE 167

Homework 1

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$C = 0.90\,mF + 0.002\,mF \cdot (\%hum)$

$V_{out} = \frac{f_c}{1000}$

$RMS = \frac{1mV}{\sqrt{Hz}}$

$f_{c_{LC}} = \frac{1}{2\pi\sqrt{LC}}$

$L = 10m\,H$

(a) using formula for V_{out} and f_c:

$$V_{out} = \frac{\frac{1}{2\pi\sqrt{LC}}}{1000} = \frac{1}{2000\pi\sqrt{.01C}}$$

$$= \frac{1}{2000\pi\sqrt{0.01\,[0.9\mu + 0.002\mu H}}$$

(b) $V_{out}(H=0) = 1.6776\ V$ = max

$V_{out}(H=100) = 1.517\ V$ = min

$V_{out}(H=50) = 1.592\ V$

$C(50\%)_{nominal} = 1mF$

$V_{out}(H=50, C=1mF)_{nominal} = 1.59155\ V$

$Offset = V_{out}(H=50)_{nominal} - V_{out}(H=50)$

$= 0.00046$

(c) s = sensitivity, nom = nominal

$$s = \frac{\Delta V}{\Delta H\%}$$

~~$s(@75\%) = V(H=50)_{nominal} = V(H=$~~

$$s_{nom} = \frac{V_{out}(H=50)_{nominal}}{50\%}$$

$$= \frac{1.59155}{50} = 0.0318$$

$V_{out}(H=75) = 1.55319\ V$

$V_{out}(H=100) = 1.517\ V$

$$s(@75\%) = \frac{1.55319V}{75} = 0.020709$$

$$s(@100\%) = \frac{1.517}{100} = 0.01517$$

(d)

$$f(x) = f(a) + \frac{f'(a)}{1!}(x-a) + \frac{f''(a)}{2!}(x-a)^2$$

$$f(C) = \frac{1}{2000\sqrt{LC}} - \frac{L}{4000\pi(LC)^{3/2}}(C-C_0) + \frac{3L^2}{8000\pi(LC)^{5/2}}(C-C_0)^2$$

$L = 10\,mH$, $C_0 = 1\,mF$

(f) $V_{100M\ \text{noise}} = \frac{1mV}{\sqrt{Hz}} \cdot \sqrt{f} = \frac{1mV}{\sqrt{Hz}} \cdot \sqrt{100 \times 10^6 Hz} = 10V$

(g) $V_{100Hz\ \text{noise}} = \frac{1mV}{\sqrt{Hz}} \cdot 10\sqrt{Hz} = 0.01V$

(h)

2)

$$R(T) = R_{T_0} \exp\left[\frac{\beta(T-T_0)}{T T_0}\right]$$

$T_0 = 300K$, $\beta = 3000k$, $R_{T_0} = 1000\,\Omega$

(a) I chugged every value and the equation into a calculator that does derivatives.

I get $S = \frac{1000}{300K} = 3.33\,\Omega/K$

The expansion is :

$$1000 \sum_{K=0}^{\infty} \frac{\left(10 - \frac{3000}{T}\right)^K}{K!}$$

$$R(T) = 1000 + 1000\frac{\left(10 - \frac{3000}{T}\right)^1}{1} + 1000\frac{\left(10 - \frac{3000}{T}\right)^2}{2}$$

(b) for 350K

1st = 1000
2nd = 1428.57
3rd = 1020.41

for 400K

1st = 1000
2nd = 2500
3rd = 3125

(c) $2+2 = 4-1 = 3$