Matt McDade
System Simulation
HW #3

A) $\frac{V_{out}(s)}{V_{in}(s)} = H(s) = \frac{4/3 \cdot 10^7}{s^2 + 250s + 3.33 \cdot 10^7} = \frac{4/3 \cdot 10^7}{s(s+250) + 3.33 \cdot 10^7}$

$\frac{1}{s} \leftrightarrows \frac{Tz}{z-1} \qquad s \leftrightarrows \frac{z-1}{Tz}$

$\frac{4/3 \cdot 10^7}{\frac{z-1}{Tz}\left(\frac{z-1}{Tz} + 250\right) + 3.33 \cdot 10^7} = \frac{4/3 \cdot 10^7}{\frac{(z-1)^2}{Tz^2} + \frac{250(z-1)}{Tz} + 3.33 \cdot 10^7}$

$= \frac{\frac{4}{3} \cdot 10^7 \cdot Tz^2}{z^2 - 2z + 1 + 250Tz^2 - 250Tz + 3.33 \cdot 10^7 Tz^2}$

$= z^2\left(1 + 250T + 3.33 \cdot 10^7 T^2\right) + z(-2 - 250T) + 1$

$b_2 = \frac{4}{3} \cdot 10^7 \cdot T^2 \qquad b_1 = 0 \qquad b_0 = 0$

$a_1 = -2 - 250T$

$a_0 = 1$

$y(k+2) = (2 + 250T)\,y(k+1) - y(k) + \left(\frac{4}{3} \cdot 10^7 \cdot T^2\right) u(k+2)$

B) $\frac{V_{out}(s)}{S(s)} = \frac{4 \cdot 10^8}{s^2 + 250s + 3.33 \cdot 10^7} \qquad s \leftrightarrows \frac{z-1}{Tz}$

$\frac{4 \cdot 10^8}{\left(\frac{z-1}{Tz}\right)^2 + 250\left(\frac{z-1}{Tz}\right) + 3.33 \cdot 10^7} = \frac{4 \cdot 10^8 T^2 z^2}{z^2 - 2z + 1 + 250Tz^2 - 250Tz + 3.33 \cdot 10^7 T^2 z^2}$

$= \frac{4 \cdot 10^8 T^2 z^2}{z^2\left(1 + 250T + 3.33 \cdot 10^7 T^2\right) + z(-2 - 250T) + 1}$

$a_1 = -2 - 250T \qquad b_2 = 4 \cdot 10^8 T^2$

$a_0 = 1 \qquad b_1 = 0$

$b_0 = 0$

$y(k+2) = (2 + 250T)\,y(k+1) - y(k) + \left(4 \cdot 10^8 T^2\right) u(k+2)$

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% Matt McDade
% System Simulation HW 3
% Graphs are certainly wrong but I think I'm close
close all;

T = 0.001;
x = 0:T:100;
N = length(x);

step = ones(1, N);
u_a = 12 * step;
u_b = 0.4 * step;

y_a = zeros(1, N);
y_b = zeros(1, N);

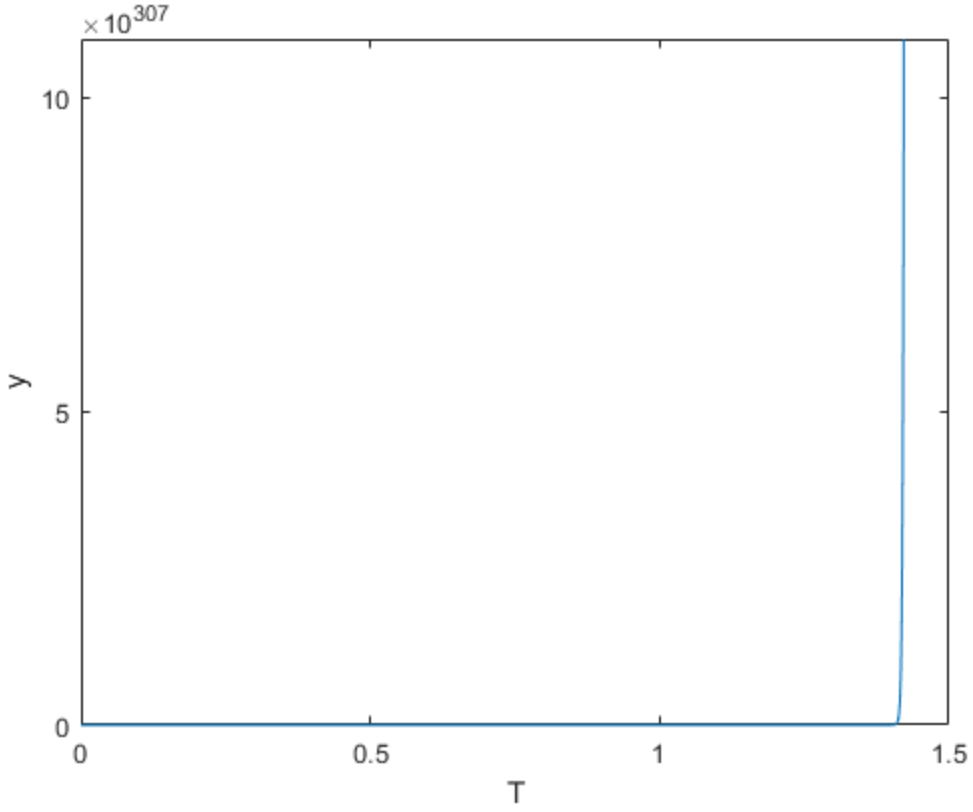
b2_a = (4/3) * 10^7 * T^2;
a1_a = -2-250*T;
a0_a = 1;

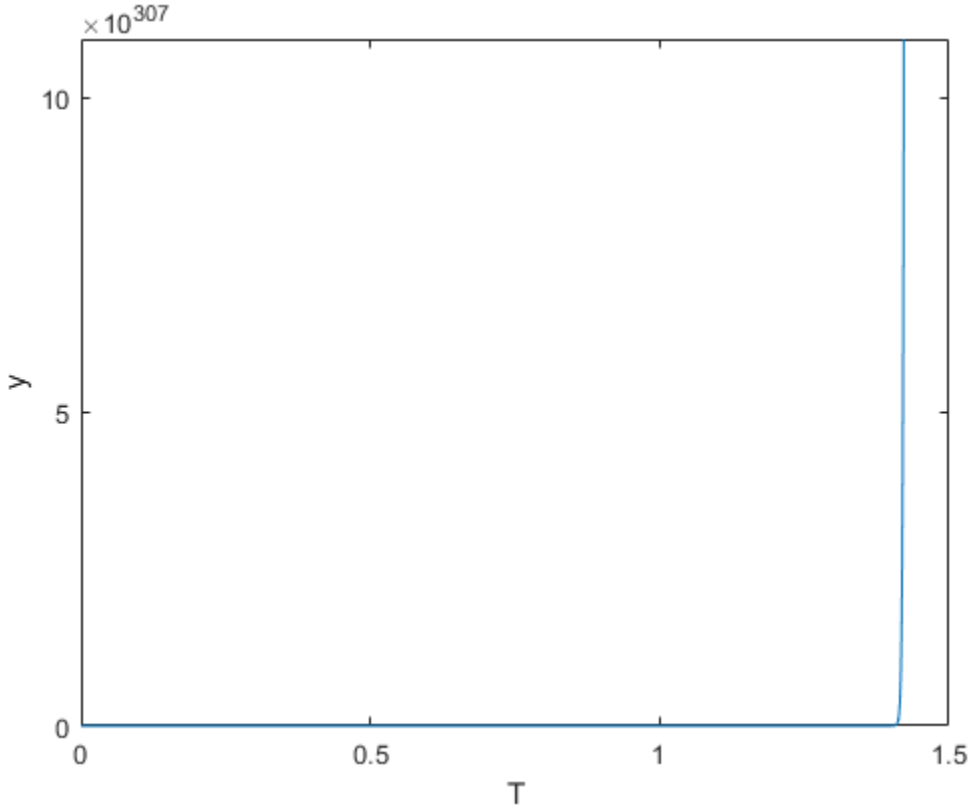
b2_b = 4 * 10^8 * T^2;
a1_b = -2-250*T;
a0_b = 1;

for k = 3:N
    y_a(k) = -a1_a * y_a(k-1) - a0_a * y_a(k-2) + b2_a * u_a(k);
    y_b(k) = -a1_b * y_b(k-1) - a0_b * y_b(k-2) + b2_b * u_b(k);
end

figure(); plot(x, y_a)
xlabel('T'); ylabel('y')

figure(); plot(x, y_b)
xlabel('T'); ylabel('y')
```


×10^307
10
5
0
y
0
0.5
1
1.5
T


×10^307
10
5
0
y
0
0.5
1
1.5
T

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