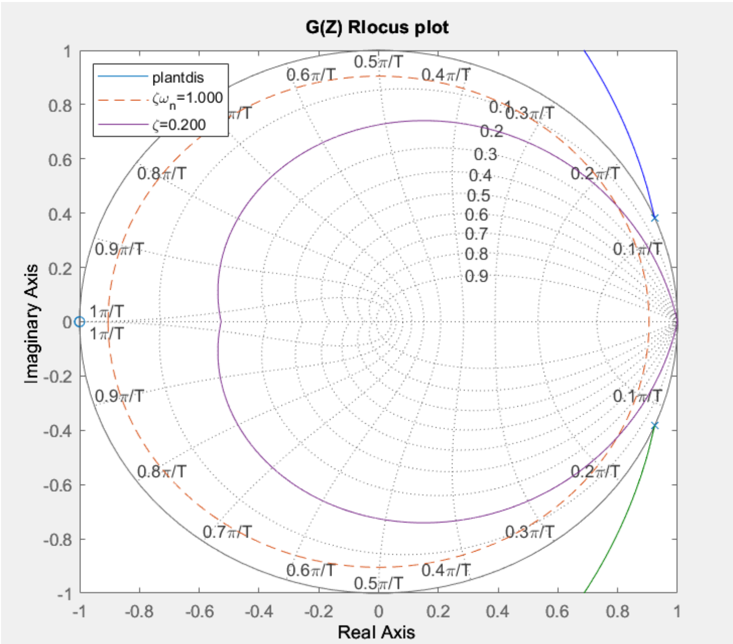
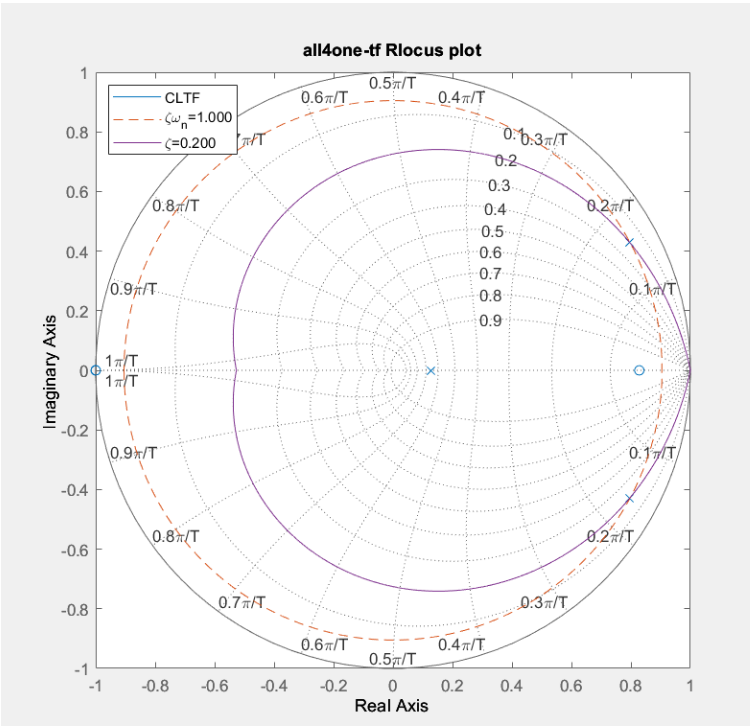
Problem 1

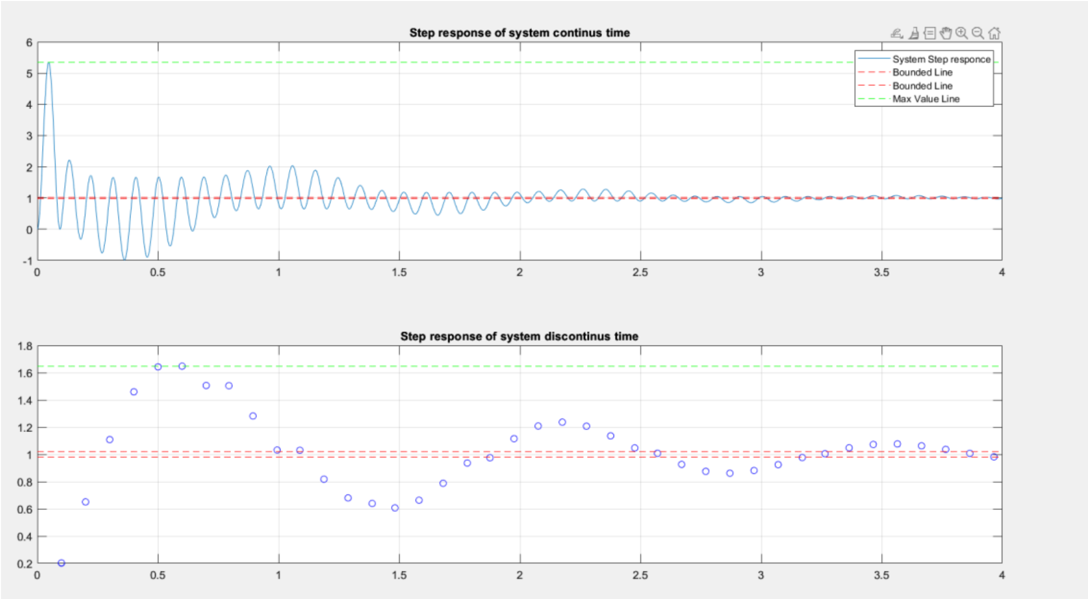
$G(z)$ *Rlocus Plot*



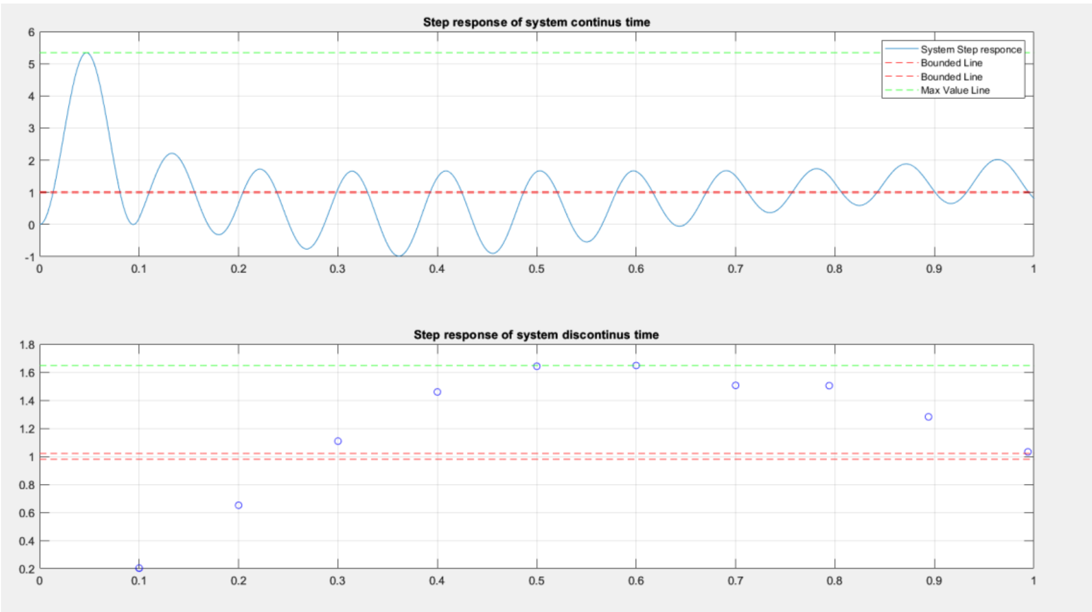
After adding a lead compensator, CLTF pole's location check



Continus and discrete time plot 4 sec *plot*



Continus and discrete time plot 1 sec *plot*



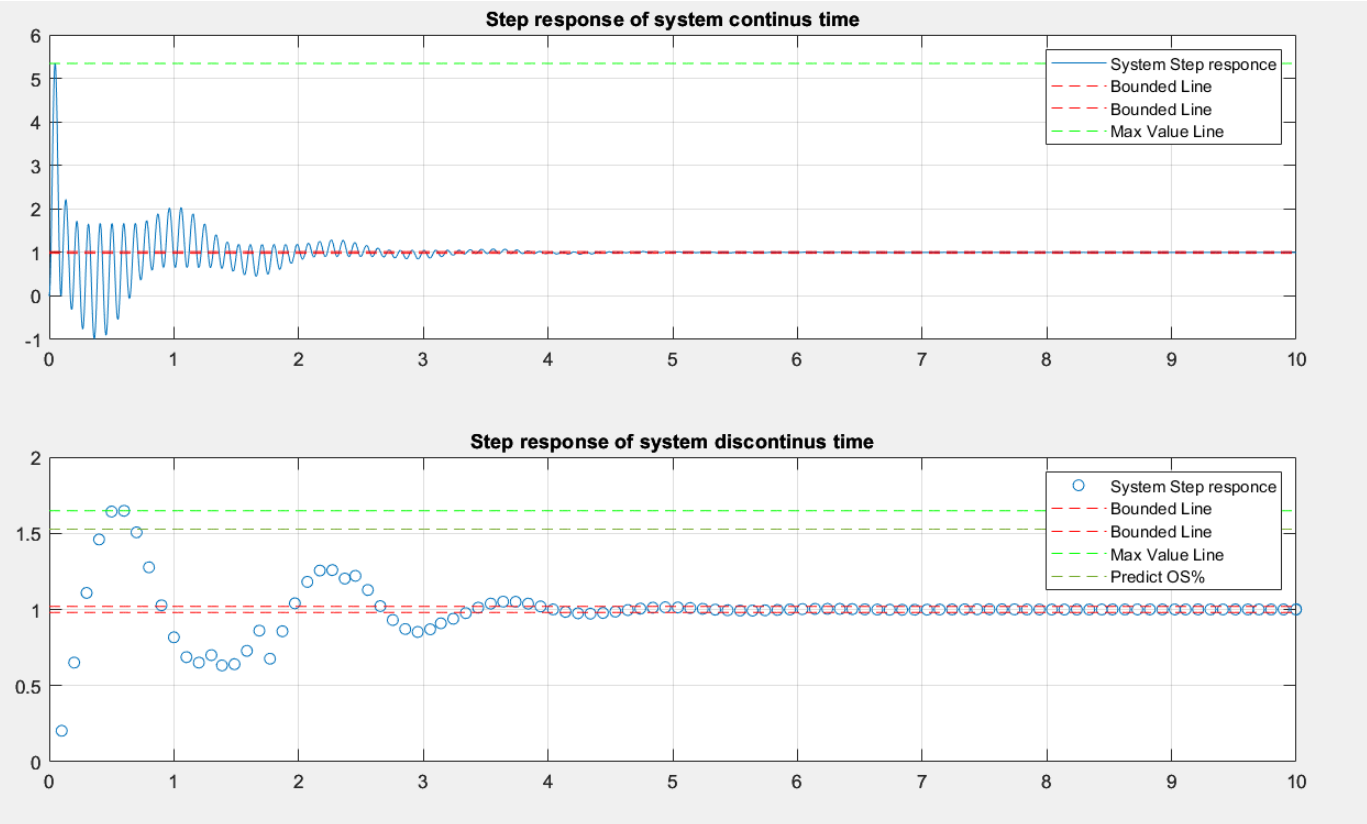
C. Explain the difference, if any, between the maximum percent overshoot in the *y* response in your plot for part (b) and that predicted by the Simple Oscillator Model.

Given $\xi : 0.2$ $\xi\omega_n : 1$

Hence, $PO\% : 100\, e^{-0.2\pi / \sqrt{1-0.2^2}} = 52.662\,\%$

D. Explain the difference, if any, between the 2% Settling Time in the *y* response in your plot for part (b) and that predicted by the Simple Oscillator Model.

$T_s \approx \dfrac{4}{\xi\omega_n} = 4.$



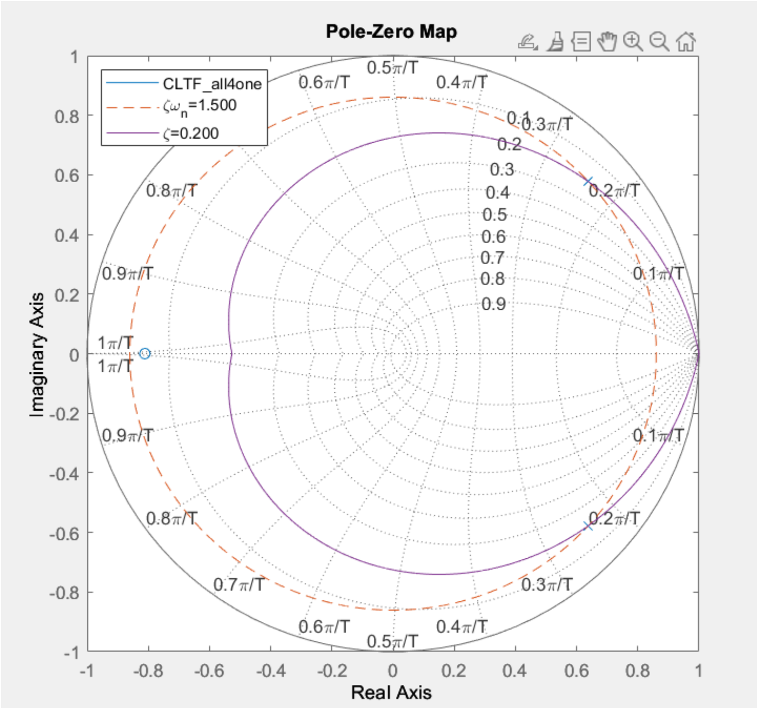
The reason behind is because, we add a lead compensator into the system. Also, according the CLTF PZ map we provided above. There is a zero located on the real axis, which is nearly 0.8. This is the reason why we got the overshoot greater than we predicted. Ts seems predict pretty well.

F. Explain the differences, if any, between the maximum percent overshoots of the continuous-time and discrete-time responses in your plot for part (e).

There is a huge difference between continuous and discrete-time outcomes. The reason behind of it because of sampling time. The sampling time is way too large that the discrete-time outcomes cannot represent the real system well. That is why there is a huge difference between them.

Problem 2

$$Gain\ K = 0.624$$



Above picture shown the CLTF of C(z) = K and plant. Poles do appear on the intersection.

B. Is the above closed-loop system Type 0, Type 1, or Type 2? Determine the value of its corresponding Unit tracking error constant (*Kp*, *Kv* or *Ka*).

Open loop transfer function = $\frac{0.624}{0.01s^2+0.06283s}$. **It is a Type1 system.**

As $\lim_{s\to 0} s * \frac{0.624}{0.01s^2+0.06283s} = 9.93156 = K_v$

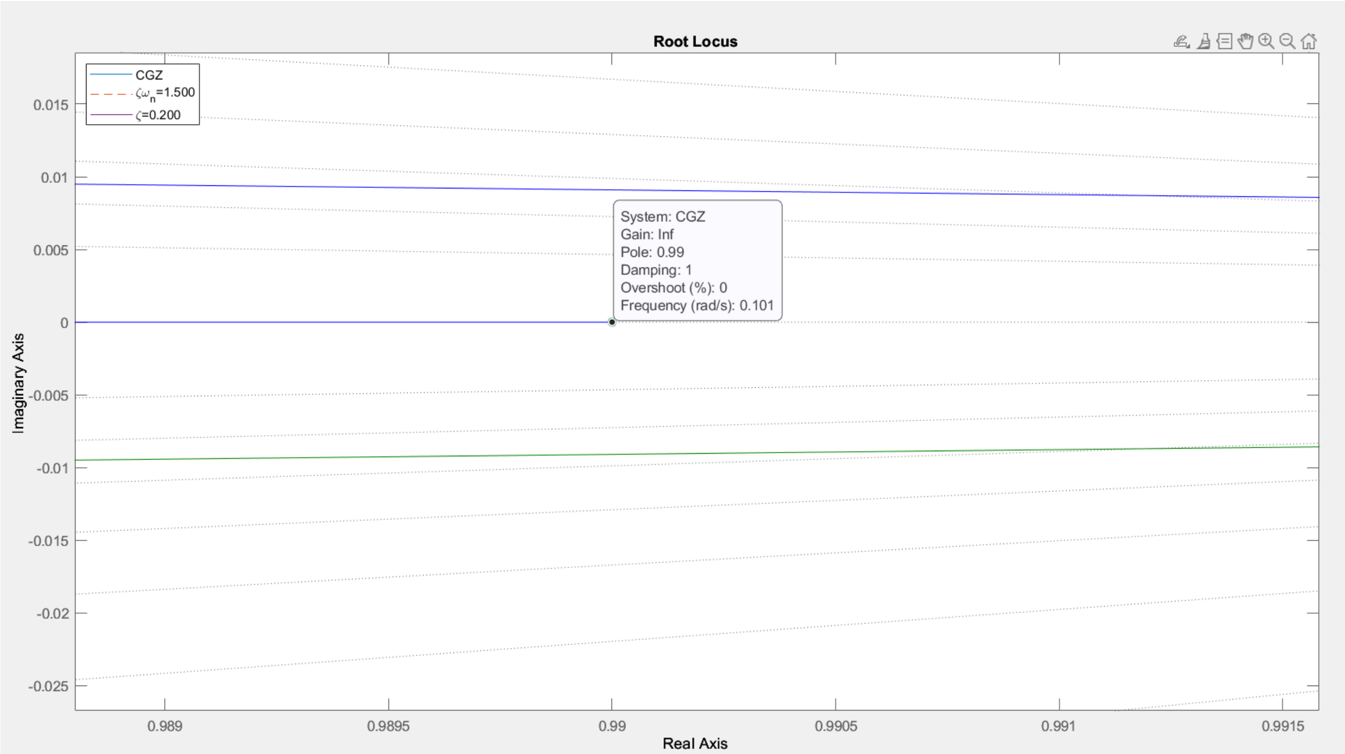
C. According the dormula $\alpha = \frac{1 - Z_z}{1 - Z_p} = 10$

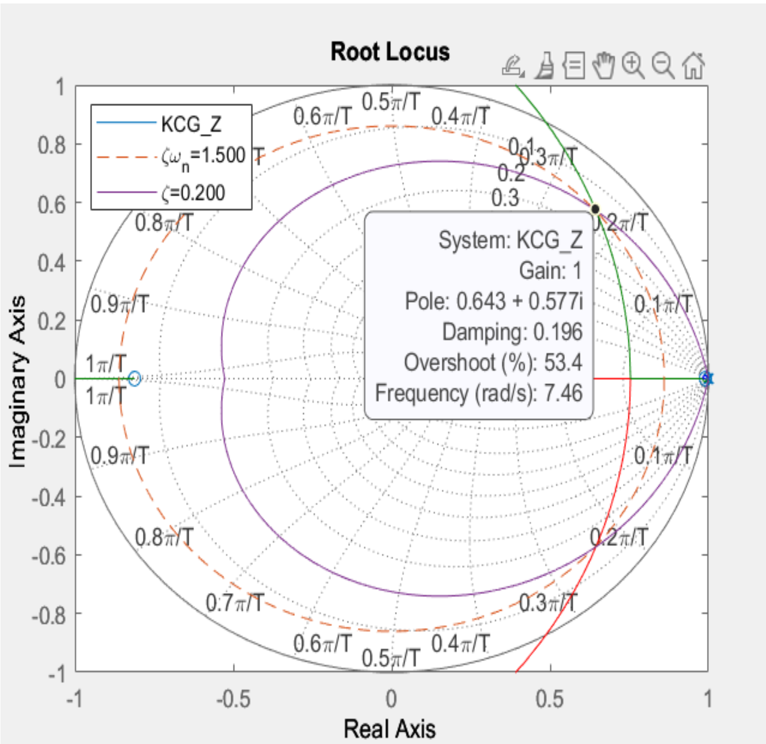
Also, Z_z , Z_p differs by 2°

We pick $Z_p = 0.999$ Near 1.

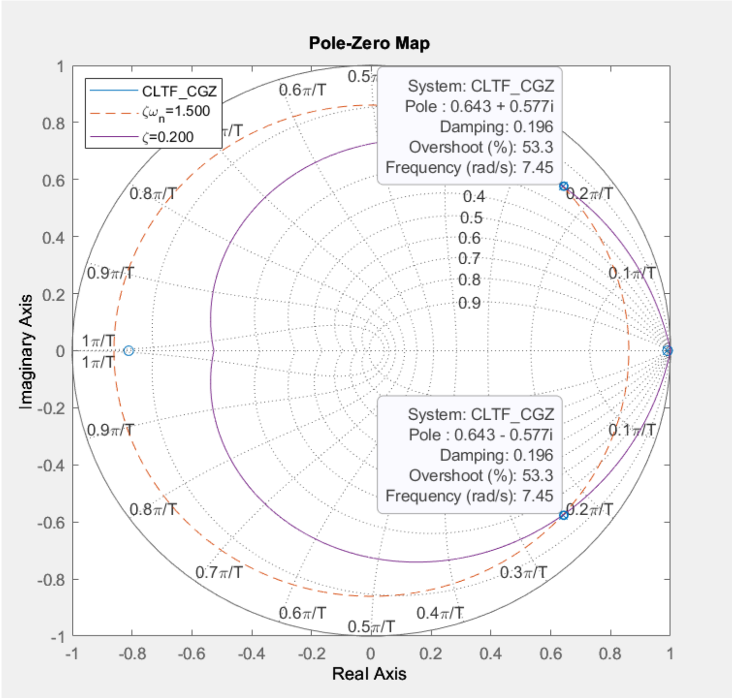
$10 = \frac{1 - Z_z}{0.0001} \Rightarrow Z_z = 0.99$

$\zeta = 1$; $\omega_n = 0.101 \Rightarrow$ Time constant $= \frac{1}{1 \cdot 0.101} = 9.9s$

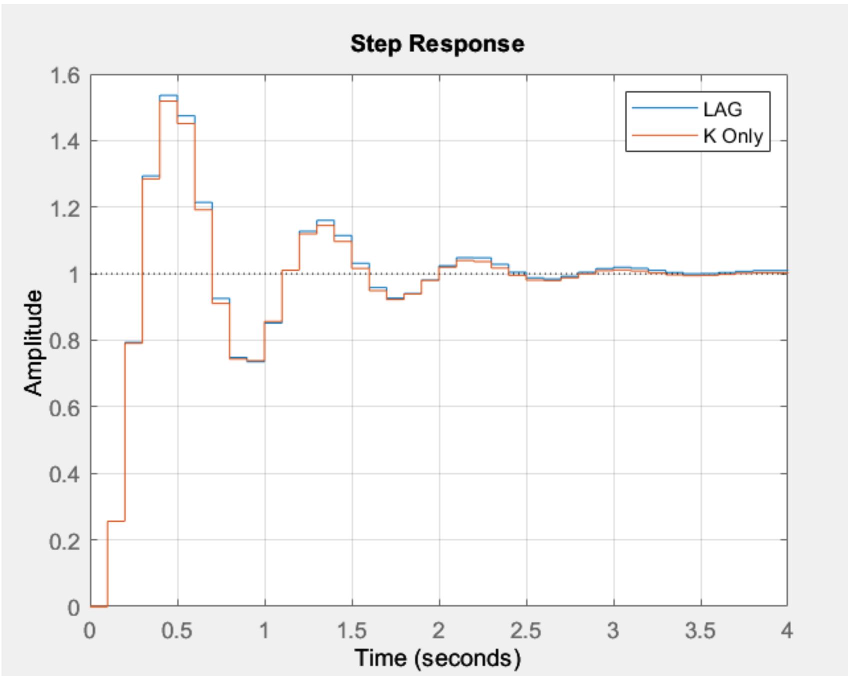

Root Locus
CGZ
$\zeta\omega_n$=1.500
ζ=0.200
System: CGZ
Gain: Inf
Pole: 0.99
Damping: 1
Overshoot (%): 0
Frequency (rad/s): 0.101
Imaginary Axis
Real Axis


Root Locus
KCG_Z
$\zeta\omega_n$=1.500
ζ=0.200
System: KCG_Z
Gain: 1
Pole: 0.643 + 0.577i
Damping: 0.196
Overshoot (%): 53.4
Frequency (rad/s): 7.46
Imaginary Axis
Real Axis

PZ-MAP CHECK



d.)



Knowing y(k+1) = y(k) + Tu(k)

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L_s = tf(1, [1, 0]);
mult = c2d(L_s, Ts);
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Transfer 1/s into z domain.

Then we can generate our output by step(mult*CLTF)