Question 18:

Graphs of inputting different inputs (Step, Ramp, and Parabolic function)  
A graph with different colored lines

Description automatically generated

A diagram of a flowchart

Description automatically generated

A graph of colored lines

Description automatically generated

18) a) by checking The system’s stability using the function Pole we get the following A math equations and numbers

Description automatically generated with medium confidence   
which is insufficient to see the stability but if we resort to an online calculator we can see the following  
A screenshot of a computer

Description automatically generated

Which means we have poles on the RHP which were too small for Matlab’s rounding errors but it indicates that the system is stable (although it is a very small value it’s trivial to show how it goes to infinity).  
After adding the lead lag controller we get the following polesA white background with black numbers

Description automatically generated

Which is a clear indication that our poles were shifted to the left and that our system is now stable

b) It’s clear to see how the error grows very quickly for any system bigger than the ramp’s as shown in the following

A close up of words

Description automatically generated

Question 19:

Before tuning

A screenshot of a computer

Description automatically generated

Question 20:

Kc =

P1 =

Z1 =

P2 =

Z2 =

Info after tuning

Question 21:

It’s obvious from the previous graphs that the steady state error and other desired values have improved after tuning the controller parameters.

In addition, we’ve already shown how this controller changes our previous unstable system into a stable one.

Question 22:

Root Locus after tuning

Question 23:

Bode plot after tuning