Control System Laboratory Report

Name and ID no. of the Student:

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Title of the Experiment:

Root Locus for Stability Analysis

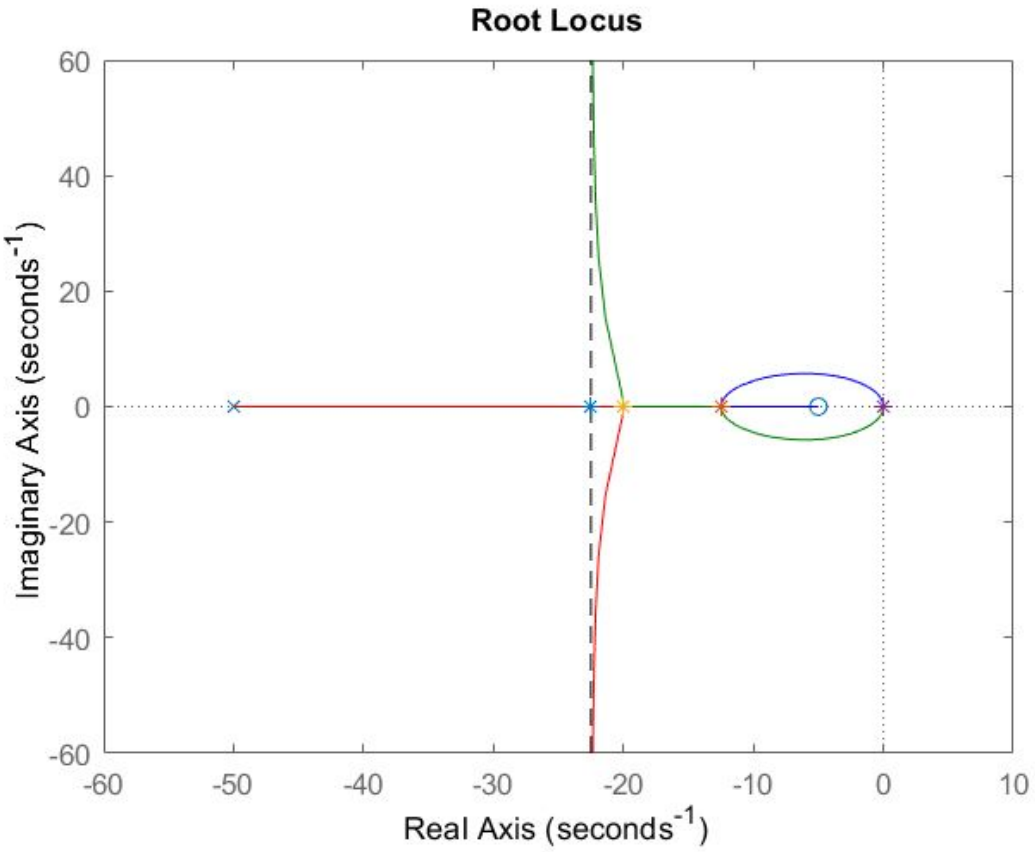
Model/Simulation:

```
num= [80 400];
den= [1 50 0 0];
sys=tf(num,den)
rlocus (sys);
pole(sys)
zero(sys)
y=[-100,100];
x=[-22.5 -22.5];
line(x,y,'Color','black','LineStyle','--')
hold on
plot(-22.5,0,'*'); % centroid point plotting.
% break-in and break-away points plotting.
plot(-12.5,0,'*');
plot(-20,0,'*');
plot(0,0,'*');
```

‘*’ is used to indicate the centroid and,

‘*’ is used to indicate the break-in and break-away points.

Results:



where the black dotted line shows the asymptotes at the centroid s = -22.5 and the asymptotic angles are +90° and -90°.

Conclusive remarks:

Root Locus is a graphical representation of poles of a system and observing the changes in the system's poles with variation of the gain(K).

The closed loop negative feedback system has three poles(n=3) and one zero(m=1).

Number of Root Locus branches is 3 since the number of branches equals the number of poles and also the root locus has two asymptotes(n-m=2).

Since there are 2 asymptotes two poles reach two infinite zeros along the asymptotic axis.

The angle of asymptotes is given by

$= (2k + 1) * 180/(n - m),\ where\ k\ =\ 0, 1, ..., (n - m - 1)$.

so $\boldsymbol{\phi}$ = 90°, 270° or -90°

Centroid(σ) = (sum of pole - sum of zeros)/(n-m)

$$\sigma = -22.5$$

And we get the break in and away points by diff the eqn 1+k*G(s)H(s) = 0 w.r.t s.

and we get s = -20, 0 as breakaway points.

and s = -12.5 break in points.

The system is marginally stable even though there are no poles on the imaginary axis as there are 2 poles at the origin and there are no poles on the right side of imaginary. There is a dominant pole for the system which is at -50.

The root locus is symmetrical with respect to the real axis since the Poles exist in imaginary pairs.