ECE 141 Homework 4

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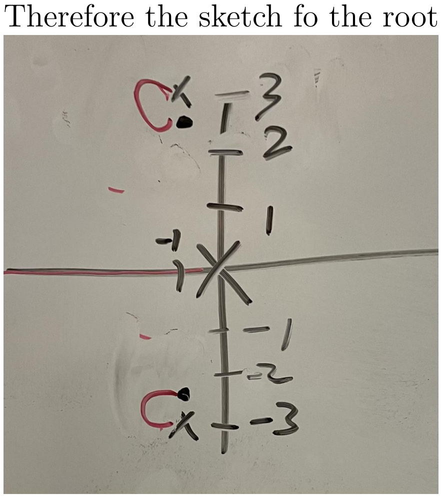
Problem 5.5

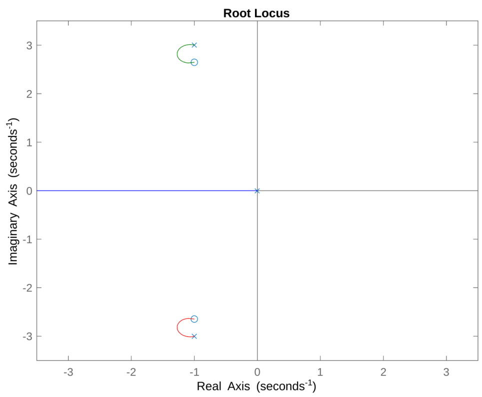
(c)

$L(s)$ has zeros at $\frac{-2\pm j2\sqrt{7}}{2}$, and poles at 0 and $\frac{-2\pm j6}{2}$, therefore we have $\alpha = 0$ $\phi_1 = 180°$, And the departure angle for poles $-1 \pm 3j$ is $\pm 161.565°$, And the arival angle for the zeros $-1 \pm \sqrt{7}j$ is $\pm 200°$

Therefore the sketch fo the root locus looks like the following



This coresponds well with the matlab root locus plot:



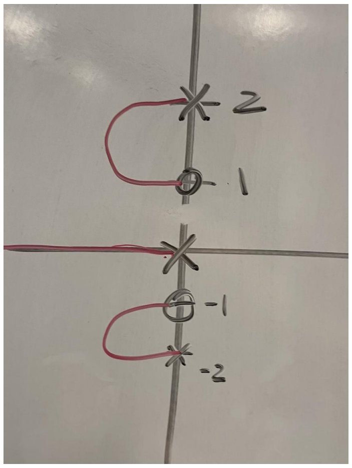
That was produced with this code

```
sys = tf([1 0 1],[1 0 4 0]);
rlocus(sys)
ylim([-2.5 2.5])
xlim([-2.5 2.5])
```

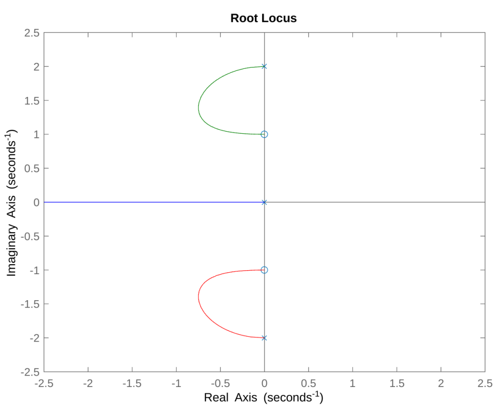
(e)

$L(s)$ has zeros at $\pm j$, and poles at 0 and $\pm 4j$, therefore we have $\alpha = 0$ $\phi_1 = 180°$, And the departure angle for poles $\pm 2j$ is $180°$, And the arival angle for the zeros $\pm 1j$ is $180°$

Therefore the sketch fo the root locus looks like the following



This coresponds well with the matlab root locus plot:



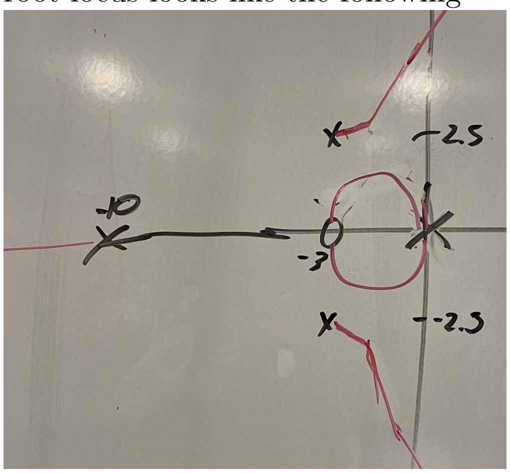
That was produced with this code

```
sys = tf([1 2 8],[1 2 10 0]);
rlocus(sys)
ylim([-3.5 3.5])
xlim([-3.5 3.5])
```

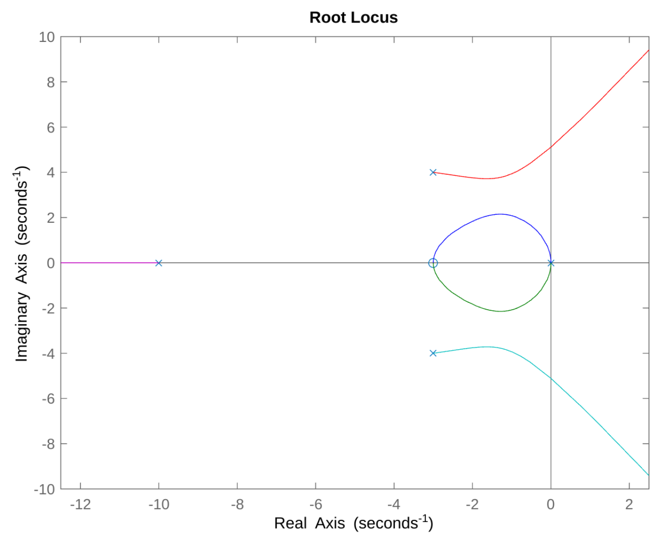
Problem 5.7

(c)

This functions has 2 zeros at -3 and 5 poles: 2 at 0, 1 at -10, and 2 at $-3 \pm \frac{5j}{2}$ Therefore $\alpha = -3.333$ and and that the three branches intersecting the real axis, intersect at degrees of $60°$, $180°$, and $300°$, therefore we have
for pole $-10 + 0j$, departure angle 1: $180°$
for poles $-3 \pm 2.5j$ the departure angles are $\pm 30°$
for the dual poles at the 0 the departure angles are $\pm 90°$
for the dual zeros at 0 the arrival angles ar $\pm 90°$ Therefore the sketch fo the root locus looks like the following



This coresponds well with the matlab root locus plot:



That was produced with this code

```
sys = tf([1 6 9],[1 16 85 250 0 0]);
rlocus(sys)
ylim([-10 10])
xlim([-12.5 2.5])
```

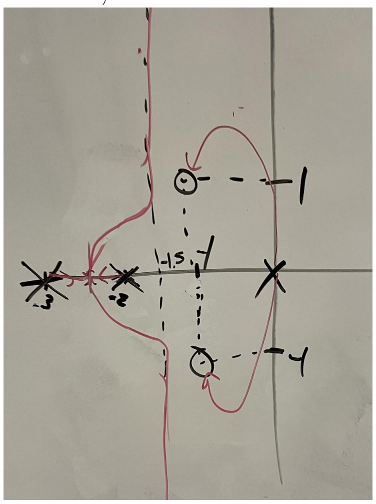
(e)

$L(s)$ had zeros at $-1 \pm 1j$ and 4 poles, 2 at 0, 1 at -2 and -3. Therefore we have

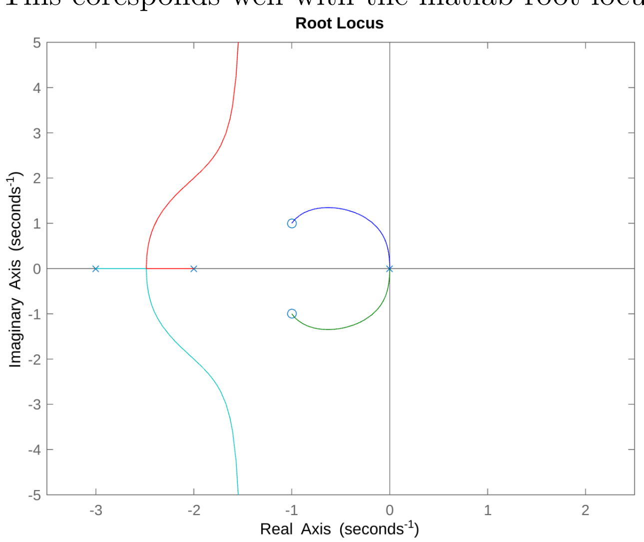
$$\alpha = -2.5$$

And there are two lines asymptomatic to this at angles of $\pm 90°$
We have
for pole -3, departure angle 1: $0.0°$
for pole -2, departure angle 1: $180°$
for pole 0, departure angle 1: $270°$
for pole 0, departure angle 2: $90°$
for zero $-1 \pm 1j$, arrival angle: $\pm 71.565°$
Furthermore from Rule 6 we have that there are mutliple roots where $s =$

−2.485, therefore the sketch of the root locus looks like



This coresponds well with the matlab root locus plot:



That was produced with this code

```
sys = tf([1 2 2],[1 5 6 0 0]);
rlocus(sys)
ylim([-5 5])
xlim([-3.5 2.5])
```

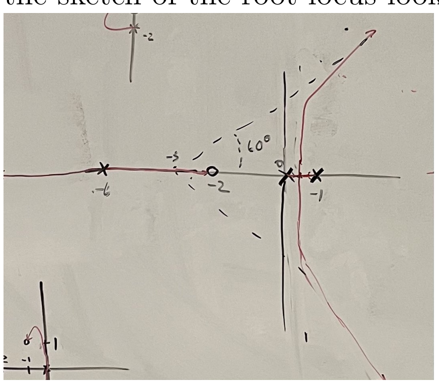
Problem 5.8

(e)

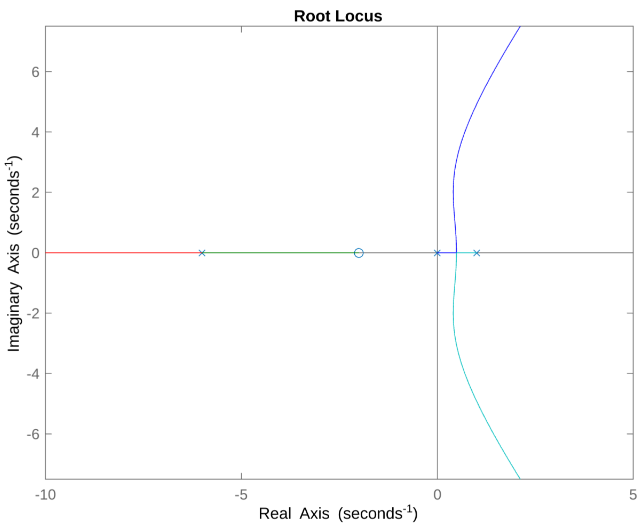
$L(s)$ has a zero at -2 and 4 poles, 2 at -6, one at 0, and one at 1. Therefore,

$$\alpha = -3$$

and three lines are asymptomatic to it at angles of 180, 60, and 180. For the poles we have that:
for pole -6, departure angle 1: 180°
for pole -6, departure angle 2: 0°
for pole 0, departure angle 1: 0°
for pole 1, departure angle 1: 180°
and for the zero we have that the angle of arival is 180°, Furthermore from Rule 6 we have that there are multiple roots where $s = -6, 0.488$, therefore the sketch of the root locus looks something like



This coresponds well with the matlab root locus plot:



That was produced with this code

```
sys = tf([1 2],[1 11 24 -36 0]);
rlocus(sys)
ylim([-7.5 7.5])
xlim([-10 5])
```