HW6
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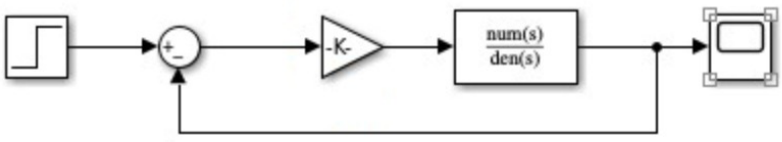
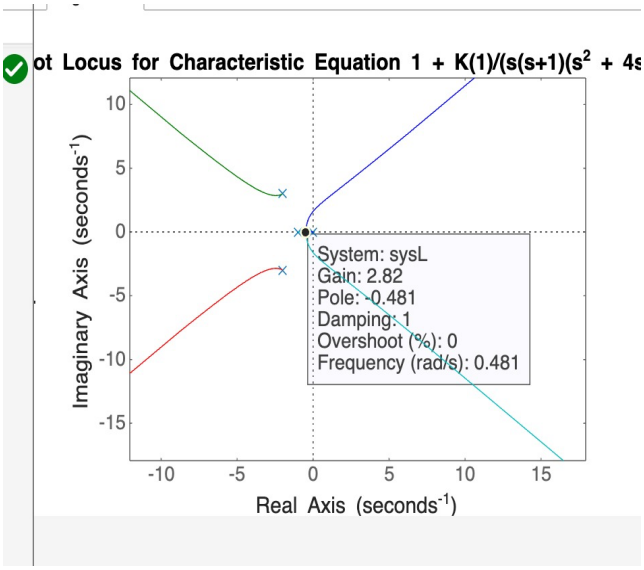
Question 1)

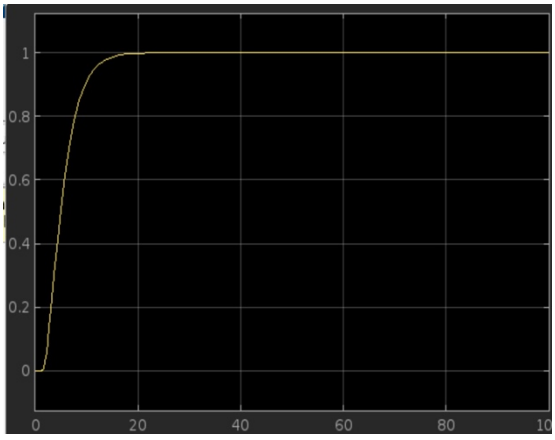
We obtain the root location using rlocus function.

```
numL = 1 ; denL = [1 5 17 13 0];
disp(['L(s) = ', poly2str(numL,'s'), '/', poly2str(denL, 's')]);
disp(' ');

% open figure 2
figure(2);

% define transfer function object for L(s)
sysL = tf(numL, denL);

% plot closed-loop system's root locus
rlocus(sysL);
title('Root Locus for Characteristic Equation 1 + K(1)/(s(s+1)(s^2 + 4s + 13)');
```



System under analysis





As we can see, the gain 2.82 gives us aperiodic stable response based on the root locus and it is clearly justified in the scope output of above system. (we don't have imaginary part for s* by setting k to 2.82)

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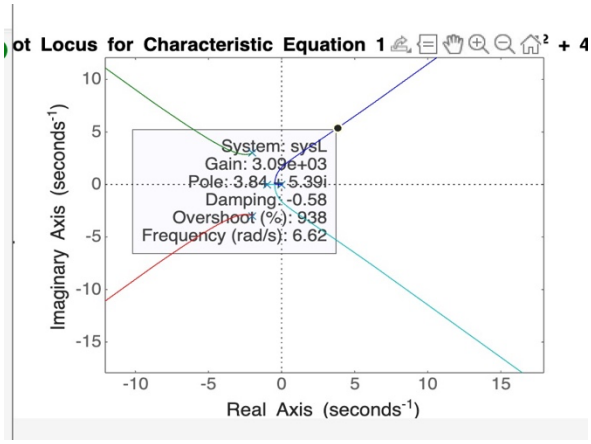

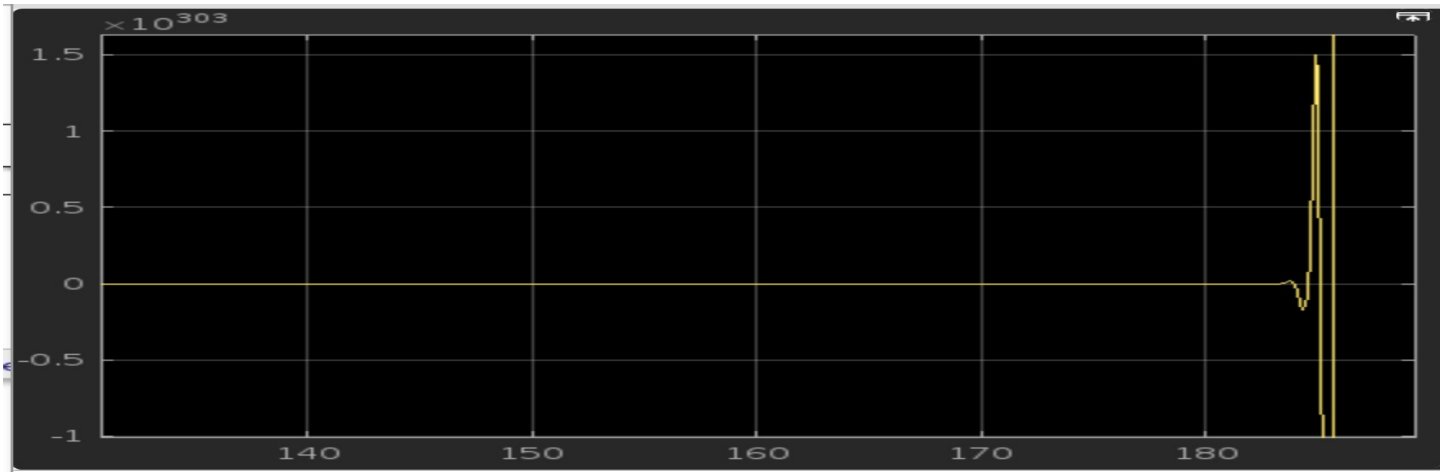

The gain 3000 based on root locus gives us unstable and periodic response which is also backed up by the output of the scope. (we have imaginary part for s* by setting k to 3000)

Question 2)

We use Routh stability criterion and we obtain the inequality as below:
The manual calculation is in the HW6 file.

```
% Define the range for k
k = linspace(0.1, 10, 500); % Avoid k=0 to prevent division by zero

% Compute the values for Kh based on the inequality
Kh = (k - 1 - k.^2) ./ (10 * k);

% Plot the inequality
figure;
hold on;
plot(k, Kh, 'r', 'LineWidth', 2);

% Define a range for Kh
Kh_min = min(Kh) - 1;
Kh_max = max(Kh) + 1;

% Shade the region where the inequality holds
fill([k, fliplr(k)], [Kh_max*ones(size(k)), fliplr(Kh)], 'g', 'FaceAlpha', 0.3);

% Add labels and legend
xlabel('k');
ylabel('K_h');
title('Region where K_h > (k - 1 - k^2) / (10k)');
legend('K_h > (k - 1 - k^2) / (10k)', 'Feasible Region', 'Location', 'Best');
grid on;
hold off;
```