EE352 Automatic Control Assignment - Question 1

Computer Aided Control Systems Analysis

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1. Define System Parameters

Analysis of a second order system G(s) described by:

$$G(s) = \frac{SE}{yy \cdot s^2 + mm \cdot s + dd}$$

Where the parameters are derived from the Date of Birth (2003-01-18) and Serial Number.

```
clc;
clear;
close all;

% Parameters
yy = 3;
mm = 1;
dd = 18;
SE = 291;

fprintf('Parameters: yy=%d, mm=%d, dd=%d, SE=%d\n', yy, mm, dd, SE);
```

```
Parameters: yy=3, mm=1, dd=18, SE=291
```

Q1a: Roots and Stability

We define the denominator polynomial $D(s) = yy \cdot s^2 + mm \cdot s + dd$ and find its roots to determine individual pole locations.

Stability Condition: If all poles have negative real parts → Stable If any pole has a positive real part → Unstable If poles are on the imaginary axis → Marginally Stable

```
num = [SE];
den = [yy, mm, dd];

p = roots(den);
fprintf('\nPoles of the system:\n');
```

```
Poles of the system:
```

```
disp(p);
```

```
  -0.1667 + 2.4438i
  -0.1667 - 2.4438i
```

```

% Check Stability
if all(real(p) < 0)
```

```
    disp('Result: The system is STABLE.');
elseif any(real(p) > 0)
    disp('Result: The system is UNSTABLE.');
else
    disp('Result: The system is MARGINALLY STABLE.');
end
```

```
Result: The system is STABLE.
```

Q1b: Transfer Function and Pole-Zero Plot

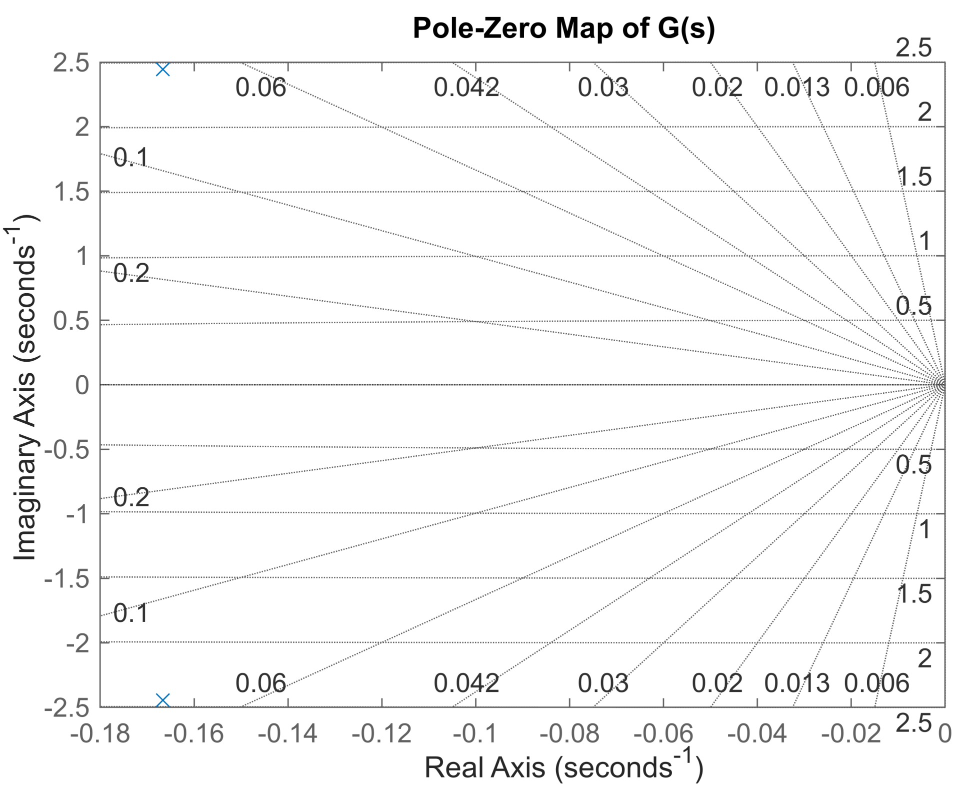
We create the Transfer Function object G(s) and plot the pole-zero map.

```
G = tf(num, den);
disp('Transfer Function G(s):');
```

```
Transfer Function G(s):
```

```


figure('Name', 'Q1b: Pole-Zero Map');
pzmap(G);
title('Pole-Zero Map of G(s)');
grid on;
```

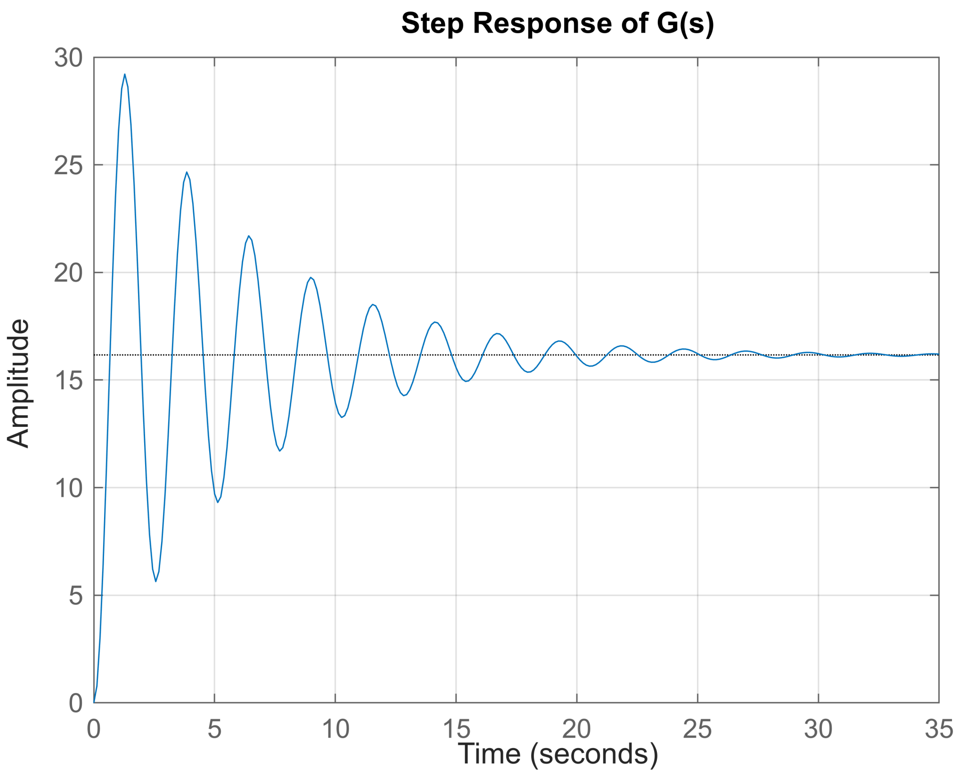


Q1c: Step Response

The step response shows the system's output behavior when the input changes from 0 to 1 instantaneously.

```
figure('Name', 'Q1c: Step Response');
step(G);
```

```
title('Step Response of G(s)');
grid on;
```



Q1d: State Space Representation

We convert the Transfer Function to a State Space representation:

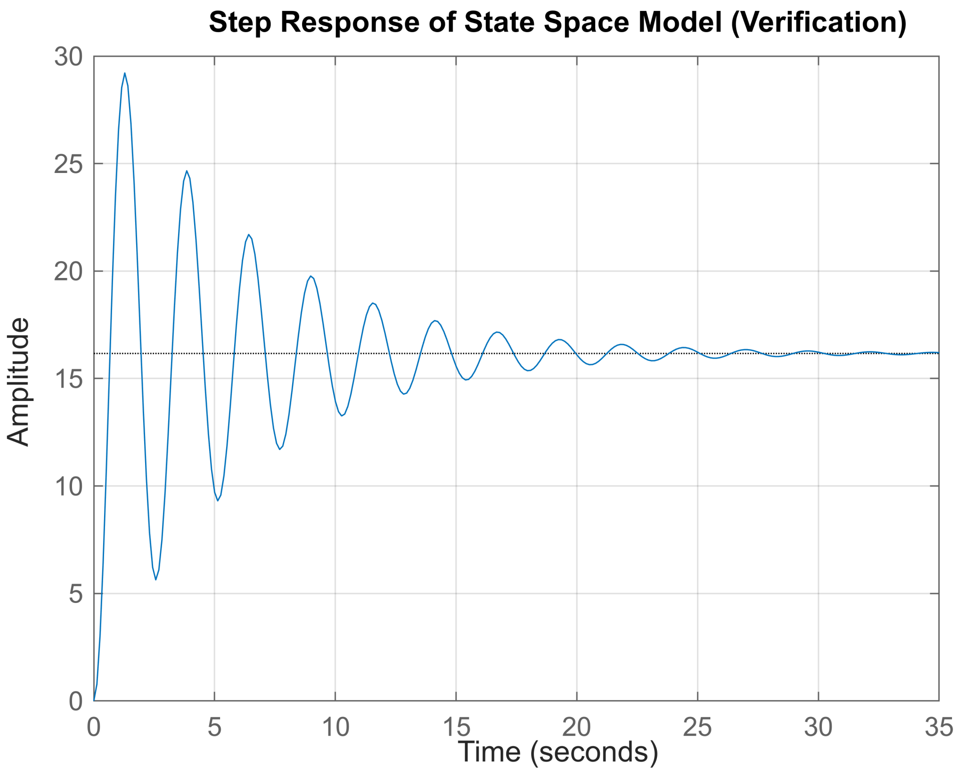
$$\dot{x} = Ax + Bu \quad y = Cx + Du$$

We then verify the conversion by plotting the step response of the state space model.

```
sys_ss = ss(G);
disp('State Space Model:');
```

```
State Space Model:
```

```
figure('Name', 'Q1d: State Space Verification');
step(sys_ss);
title('Step Response of State Space Model (Verification)');
grid on;
```


Step Response of State Space Model (Verification)
Amplitude
Time (seconds)
0
5
10
15
20
25
30
35