Experiment 8

Aim:

- Calculate the Bode Plot of
  - $\boldsymbol{G(s) = \frac{100}{s+30}}$
  - $\boldsymbol{G(s) = \frac{100(s+1)}{(s+5)(s+75)}}$
- Explore the sisotool and observe the effect of adding poles and zeros.
- Design an opamp based integrator and obtain its bode plot using Simulink/.

Software: Matlab 2018a and Simulink

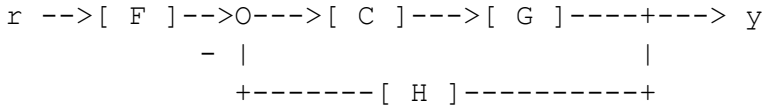
Theory:

Rules for Constructing Bode Diagrams:

1. Rewrite the transfer function in proper form. A transfer function is normally of the form rewrite this so the lowest
$$H(s) = k\frac{\sum_{i=0}^{m} b_m s^m}{\sum_{j=0}^{n} a_n s^n}$$
order term in the numerator and denominator are both unity.
2. Separate the transfer function into its constituent parts.
3. Draw the Bode diagram for each part.
4. Draw the overall Bode diagram by adding up the results from step 3**.**

Bode: Bode plot of frequency response, or magnitude and phase data. It creates a Bode plot of the frequency response of a dynamic system model sys. The plot displays the magnitude (in dB) and phase (in degrees) of the system response as a function of frequency. bode automatically determines frequencies to plot based on system dynamics.
Syntax: bode(sys)

Sisotool: sisotool opens the SISO Design Tool. This Graphical User Interface lets you design single-input/single-output (SISO) compensators by graphically interacting with the root locus, Bode, and Nichols plots of the open-loop system. To import the plant data into the SISO Tool, select the Import item from the File menu. By default, the control system configuration is



where C and F are tunable compensators.
Syntax: sisotool(G) specifies the plant model G to be used in the SISO Tool. Here G is any linear model created with TF, ZPK, or SS.

Matlab Code:

```
clc;
close all;
clear all;
s = tf('s');
```

```
G = 100/(s+30);
Y = 100*(s+1)/((s+5)*(s+75));
subplot(2,1,1),bode(G);
grid on;
subplot(2,1,2),bode(Y) ;
grid on;
sisotool(G);
sisotool(Y);
```

Result:

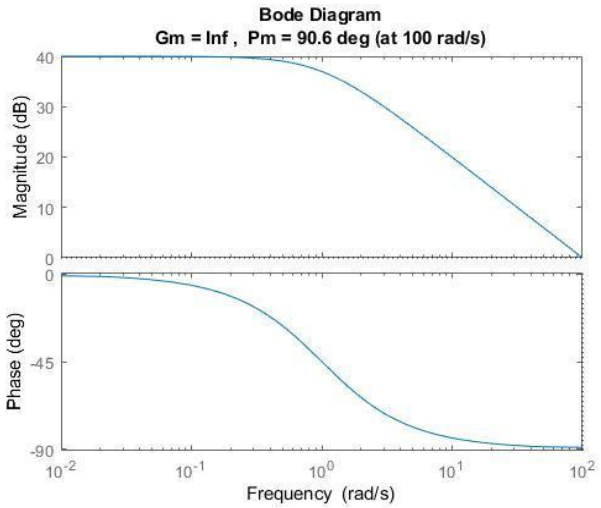


Fig. 1 Bode Plot for $G_1(s)$

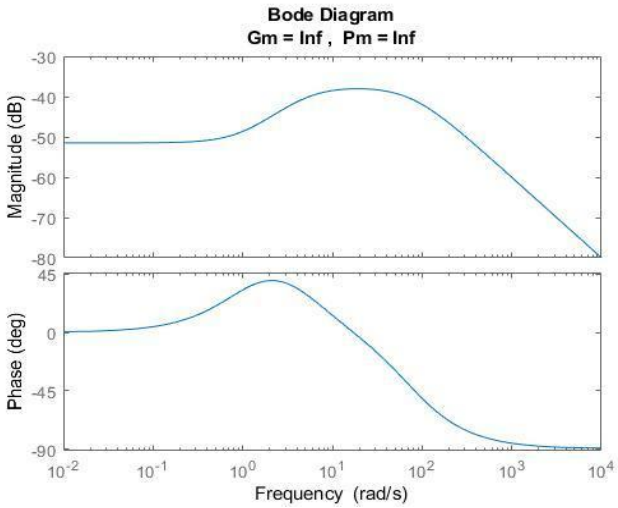


Fig. 2 Bode Plot for $G_2(s)$

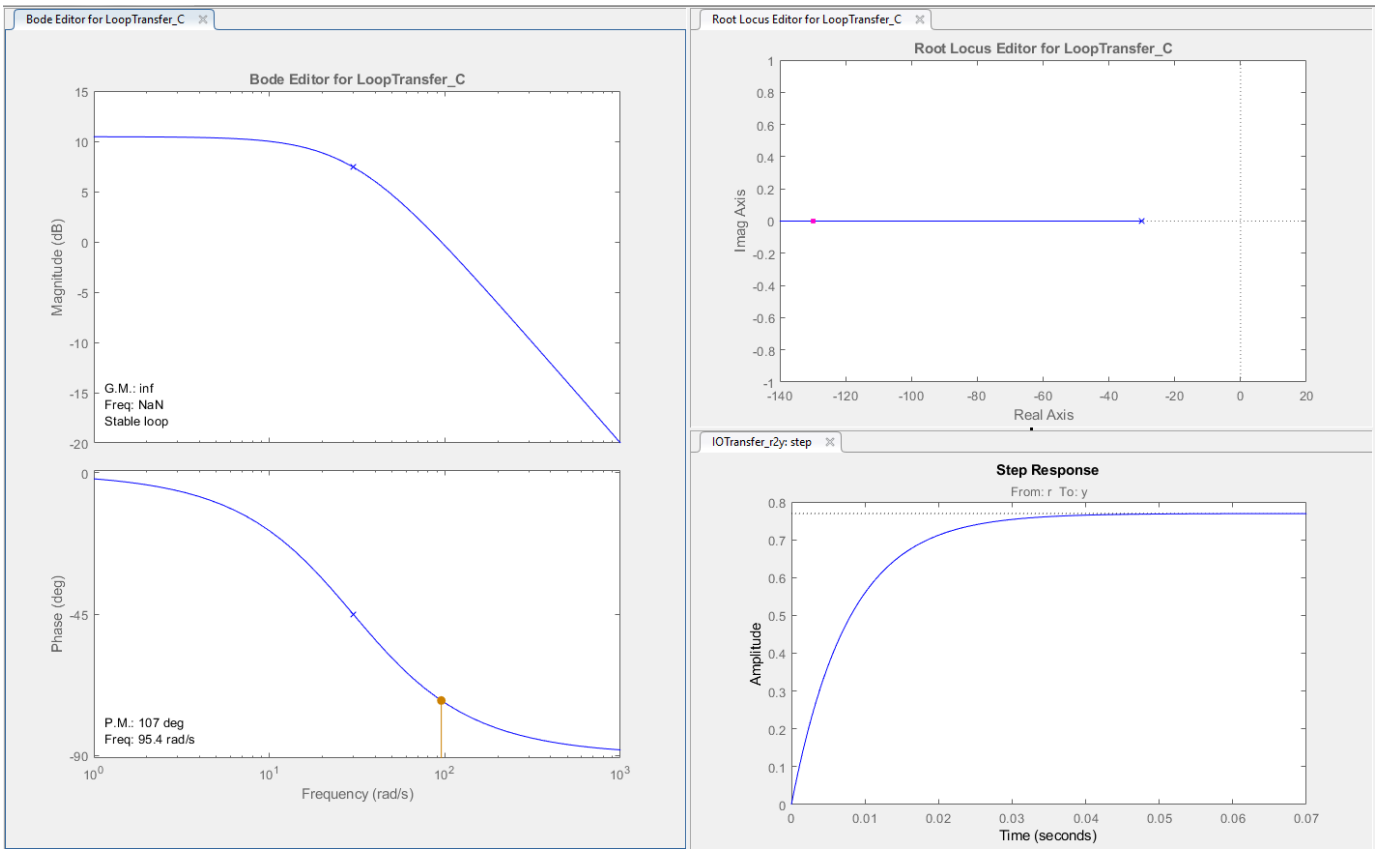


Fig. 3 SISOTOOL Plot for $G_1(s)$

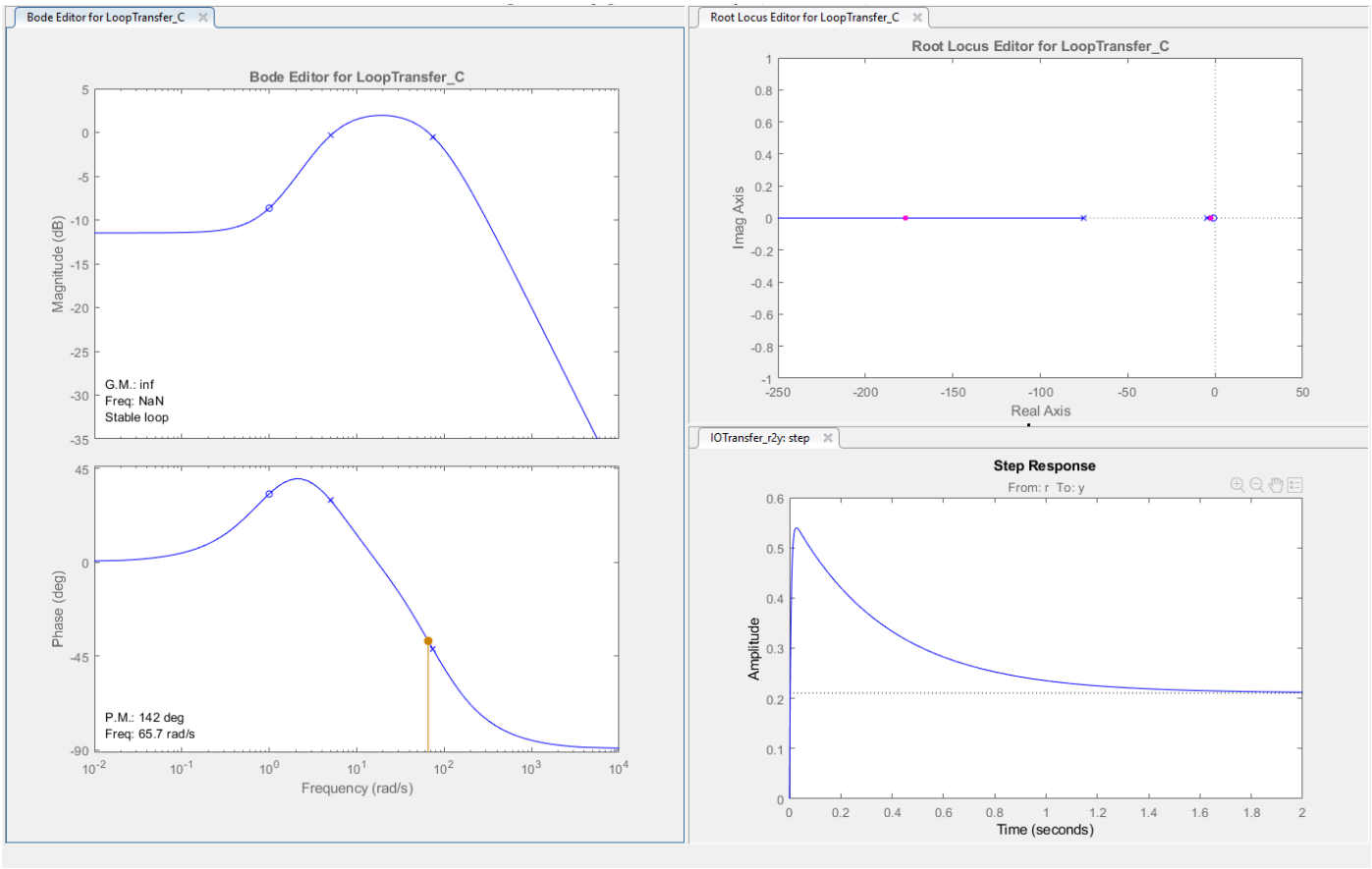


Fig. 3 SISOTOOL Plot for $\boldsymbol{G_2(s)}$

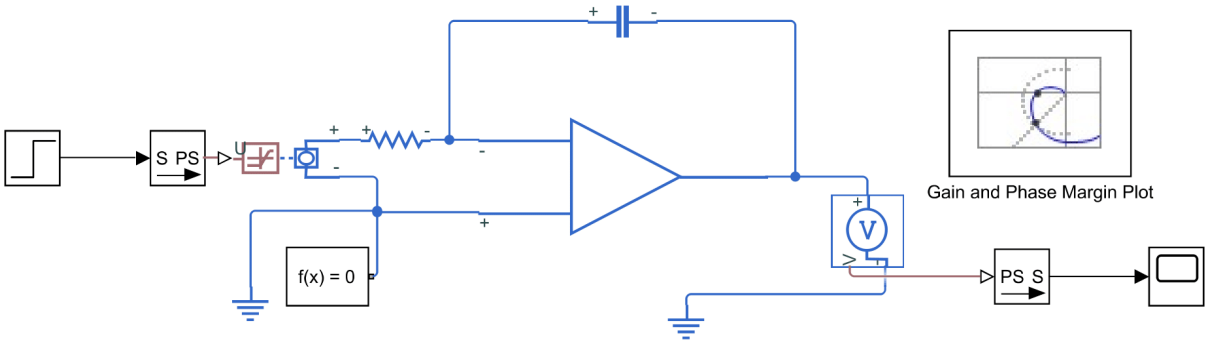


Fig. 4 SIMULINK Model for Integrator using Op-Amp

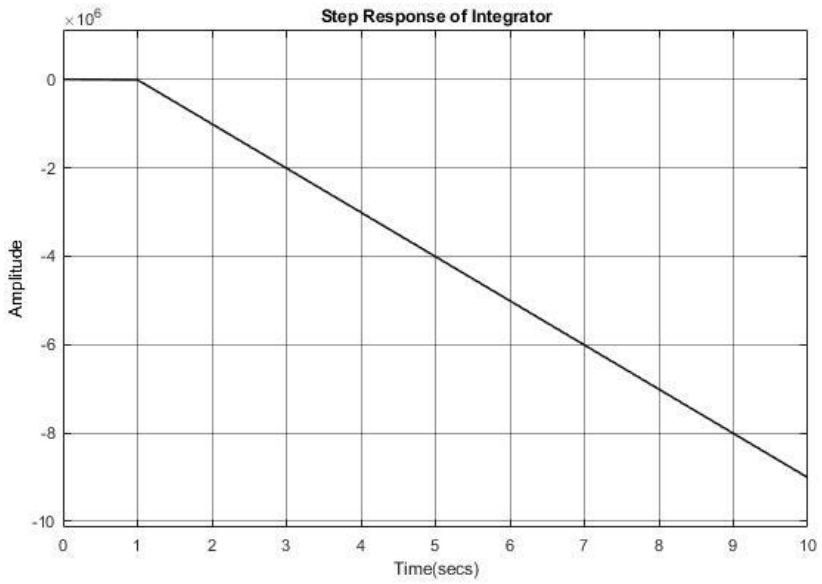


Fig. 5 Step Response for the Integrator in Time domain.

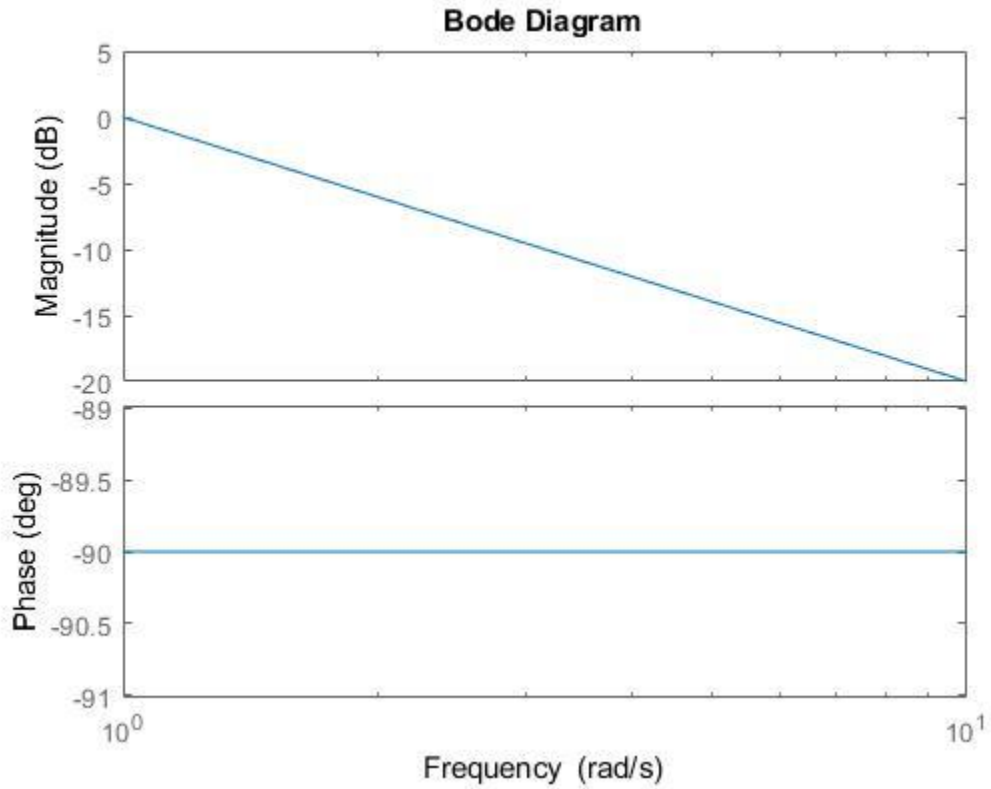


Fig. 6 Bode Plot for the Integrator.

Conclusion:

- Bode plots were studied for the given systems.
- On adding zeros, root locus is pulled towards the left half, which makes the system relatively more stable.
- On adding poles, root locus is pulled towards the right half, which makes the system relatively less stable.