Experiment No. 9

Root Locus and Bode Plots using MATLAB

AIM:

Using suitable simulation package, plot the Root Locus and Bode plot of the given Transfer function

$T(s) = \frac{s+2}{s^2+4s+3}$

THEORY:

Root locus is a graphical method in which the movement of poles in the s-plane can be located when a gain of the system is varied from 0 to infinity. The advantages of root locus are that it enhances system designing with better accuracy, helps to determine the gain margin, relative stability, phase margin, and the system's settling time, helps in analyzing the performance of the control system.

Bode Plots show the frequency response, that is changes in magnitude and phase as a function of frequency. The advantage of using Bode plot is that they provide a straightforward and common way of describing the frequency response of a linear time invariant system. This is done on semi-log scale plots: Magnitude or 'gain' plot in dB and Phase plot in degrees. The information in a Bode plot can be used to quantify the stability of a feedback system by using phase and gain margins

- Phase margin is measured at the frequency where gain equals 0 dB, also referred to as the "crossover frequency". Phase margin is a measure of the distance from the measured phase to a phase shift of -180°.
- Gain margin is measured at the frequency where the phase shift equals -180°. Gain margin indicates the distance, in dB, from the measured gain to a gain of 0 dB.

% Given Transfer Function

```
num = [1 2];
den = [1 4 3];
sys = tf(num, den);   % Transfer function 'sys' using the numerator and denominator coefficients
```

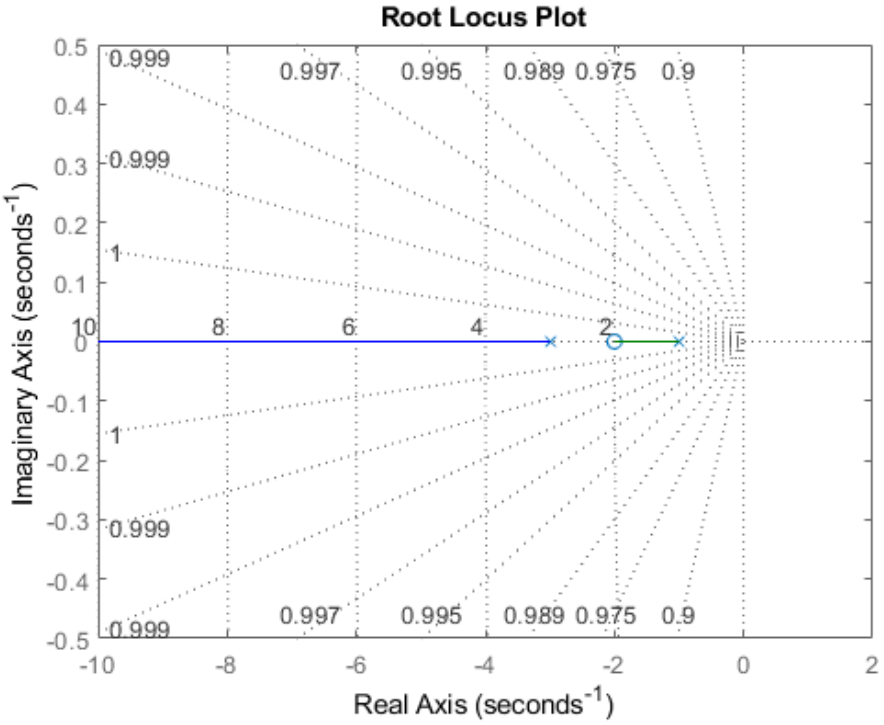
% Root Locus Plot

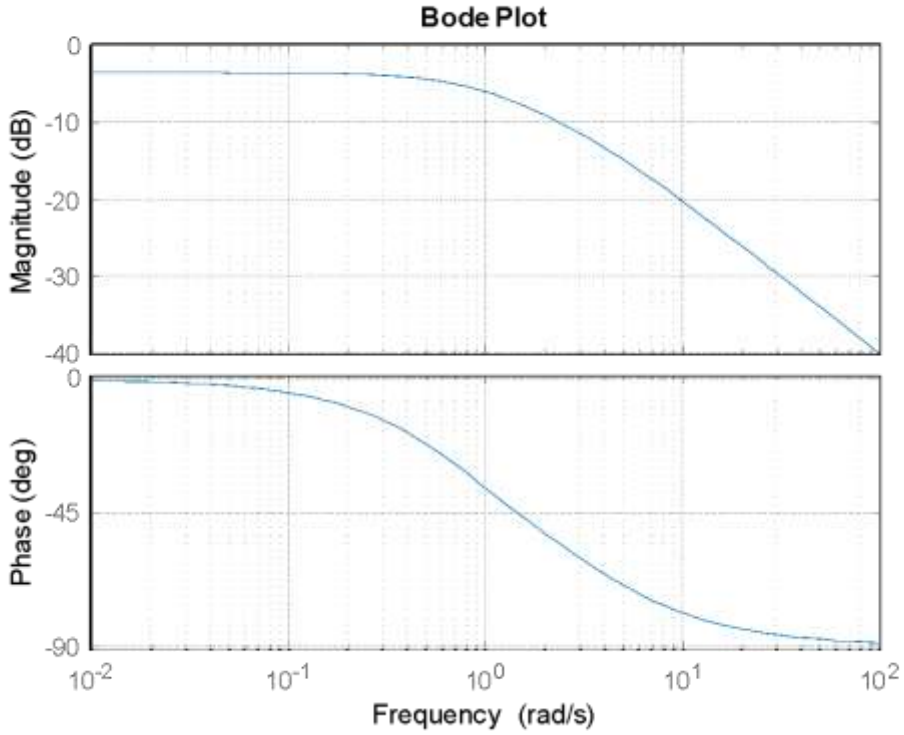
```
figure;
rlocus(sys);   % 'rlocus' function to plot the root locus of the system
grid on;
title('Root Locus Plot');
```

% Bode Plot

```
figure;
bode(sys);
grid on;
title('Bode Plot');  % 'bode' function to plot the Bode plot of the system
```

RESULT:


Root Locus Plot
Imaginary Axis (seconds^{-1})
Real Axis (seconds^{-1})
0.999
0.997
0.995
0.989
0.975
0.9
1
10
8
6
4
2
0
0.5
0.4
0.3
0.2
0.1
-0.1
-0.2
-0.3
-0.4
-0.5
-10
-8
-6
-4
-2
2


Bode Plot
Magnitude (dB)
Phase (deg)
Frequency (rad/s)
0
-10
-20
-30
-40
-45
-90
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}