I. EXPERIMENT NO. : 05

II. TITLE:

Obtaining Bode plot and Nyquist plot of different types of systems using MATLAB, and determination of their frequency domain specifications with/ without MATLAB.

III. OBJECTIVE:

To learn the process for finding the control system specifications for a particular system, from its Bode plot and Nyquist plot using MATLAB control toolbox.

IV. Work to be done in MATLAB environment:

1. Draw the Bode plot for the following system, and complete the given table.

   PROCEDURE:
   1. Open the MATLAB command window.
   2. Define the transfer function as "sys = tf(num,den)".
   3. Type the command "bode(sys)"
   4. Bode plot pops up.
   5. Right click on the graph, select 'All Characteristics' and then select desired option.

2. Draw the Nyquist plot for the following system, and complete the given table.

   PROCEDURE:
   1. Open the MATLAB command window.
   2. Define the transfer function as "sys = tf(num,den)".
   3. Type the command "nuquist(sys)"
   4. Nyquist plot pops up.
   5. Right click on the graph, select 'All Characteristics' and then select desired option.

I. The characteristic equation is $1+\frac{K}{(s+1)(s+3)}=0$. Determine the range of *K* for which the system will operate in stable zone. Then for stable zone, unstable zone and marginally stable case draw the Bode plot using the MATLAB control system toolbox.

Gain *K*	Gain crossover frequency (radian/s)	Phase margin (degree)	Phase crossover frequency (radian/s)	Gain margin (dB)	Comment on stability
					Stable
					Unstable
					Marginally stable

II. The characteristic equation is $1+\frac{K(s+1)(s+2)}{s(s+3)(s+4)}=0$. Determine the range of *K* for which the system will operate in stable zone. Then for stable zone, unstable zone and marginally stable case draw the Bode plot using the MATLAB control system toolbox.

Gain *K*	Gain crossover frequency (radian/s)	Phase margin (degree)	Phase crossover frequency (radian/s)	Gain margin (dB)	Comment on stability
					Stable
					Unstable
					Marginally stable

III. The characteristic equation is $1+\frac{K}{(s^2+6s+3)}=0$. Determine the range of *K* for which the system will operate in stable zone. Then for stable zone, unstable zone and marginally stable case draw the Bode plot using the MATLAB control system toolbox.

Gain *K*	Gain crossover frequency (radian/s)	Phase margin (degree)	Phase crossover frequency (radian/s)	Gain margin (dB)	Comment on stability
					Stable
					Unstable
					Marginally stable

IV. The characteristic equation is $1+\frac{K}{s(s+4)(s^2+4s+12)}=0$. Determine the range of K for which the system will operate in stable zone. Then for stable zone, unstable zone and marginally stable case draw the Bode plot using the MATLAB control system toolbox.

Gain K	Gain crossover frequency (radian/s)	Phase margin (degree)	Phase crossover frequency (radian/s)	Gain margin (dB)	Comment on stability
					Stable
					Unstable
					Marginally stable

V. The characteristic equation is $1+\frac{K}{s(s^2+2s+2)}=0$. Determine the range of K for which the system will operate in stable zone. Then for stable zone, unstable zone and marginally stable case draw the Bode plot using the MATLAB control system toolbox.

Gain K	Gain crossover frequency (radian/s)	Phase margin (degree)	Phase crossover frequency (radian/s)	Gain margin (dB)	Comment on stability
					Stable
					Unstable
					Marginally stable

VI. The characteristic equation is $1+\frac{K}{s(s+3)(s^2+2s+2)}=0$. Determine the range of K for which the system will operate in stable zone. Then for stable zone, unstable zone and marginally stable case draw the Bode plot using the MATLAB control system toolbox.

Gain K	Gain crossover frequency (radian/s)	Phase margin (degree)	Phase crossover frequency (radian/s)	Gain margin (dB)	Comment on stability
					Stable
					Unstable
					Marginally stable

REFERENCES :

1. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education.
2. R.C. Dorf & R.H. Bishop, "Modern Control System", 11th Edition, Pearson Education.
3. B.C. Kuo & F. Golnaraghi, "Automatic Control Systems", 8th Edition, PHI.