EE324, Control Systems Lab, Problem sheet 8
(Report submission date: 12th October 2021)

Q1) For a lag compensator with transfer function $\frac{s+K_1}{s+K_2}$

a) Keeping the ratio of K1 and K2 constant (say = 5) move both the pole and zero away from the origin and towards the origin, and comment on the transient behavior of the system.
b) What can you comment on the impulse response of the system as you move the pole and zero in the same manner as in the above (1a)?

Q2) Find a transfer function that is open-loop stable and has two intersections of the root locus on the imaginary axis. (Hence, you will get two phase-crossover frequencies), using the following steps:
a) Consider 4 non-repeating poles on the imaginary axis and one real pole. (For example, − 1, ± $2i$, ± i and plot the root locus.
b) Now shift the origin of the root locus such that all the poles lie in the left half-plane (refer to question 2d of problem sheet 5 for a hint). Plot the corresponding bode plot of this system
c) Now using the above bode plot, design the location and number of zeros to achieve two phase-crossover frequencies.
d) Plot the root locus of the new system and verify that it satisfies the problem statement.

Q3) For the magnitude plot shown (an actual magnitude plot and its asymptotic approximation is given) in the figure below, figure out the corresponding transfer function. Afterward, plot the phase plot for the same.

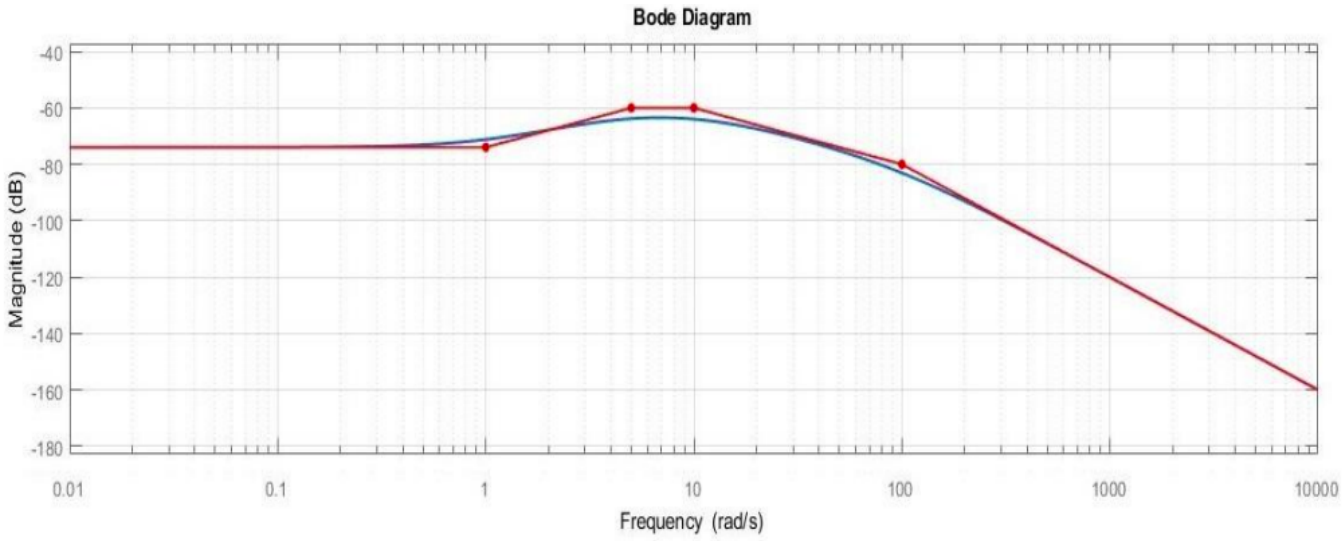

Fig: Magnitude plot of the transfer function

Report Format:

Q1)

a) Show the plot of step response for various values of pole-zero location and write your observations from the plot.
b) Show the plot of the impulse response for various values of pole-zero locations (maintaining K1/K2=Constant) and write your observations from the plot.

Q2)

a) Show the plot of the root locus.
b) Show the Bode plots.
c) Show the calculation of zeros location.
d) Show root locus for the new system.

Q3)

a) Show the calculation of the Transfer Function.
b) Show the phase plot.

Note:

- **At least these are things to be added to the report and if anyone wants to add extra required plots/values can be also added.**
- **Add the Scilab code for all questions.**