EE324, Control Systems Lab, Problem sheet 8
(Report submission date: 22nd March 2021)

Q1) For the open loop transfer function $\frac{1}{s(s^2+4s+8)}$

a) find the value of K (gain) for which the closed loop characteristic equation has gain and phase margin equal to zero.
b) Can you have a K for which the gain margin is non zero but phase margin is 0? And vice versa?
c) Can you comment on the stability of the system for the K in part a?

Q2) 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 (2a)?

Q3) 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, $-1, \pm 2i, \ \pm i$ 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.

Q4) 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. Afterwards, plot the phase plot for the same.

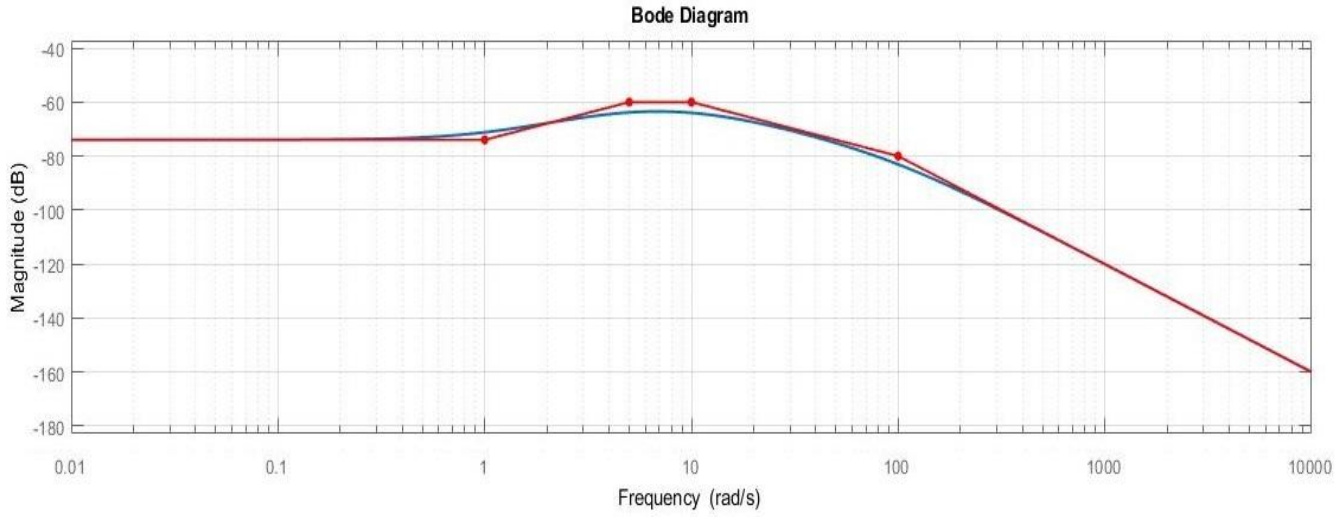

Fig: Magnitude plot of the transfer function