YTU, EEF, DEPARTMENT OF CONTROL & AUTOMATION ENGINEERING
KOM3742 CONTROL SYSTEM DESIGN, Homework-1

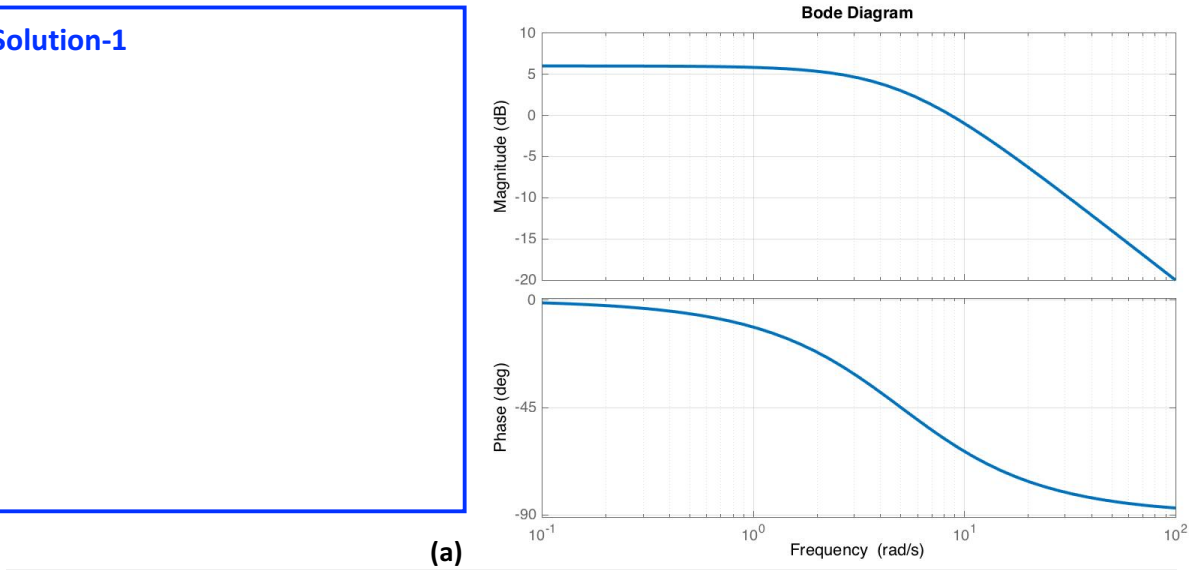
Name and Surname:

Student number: **Signature:**

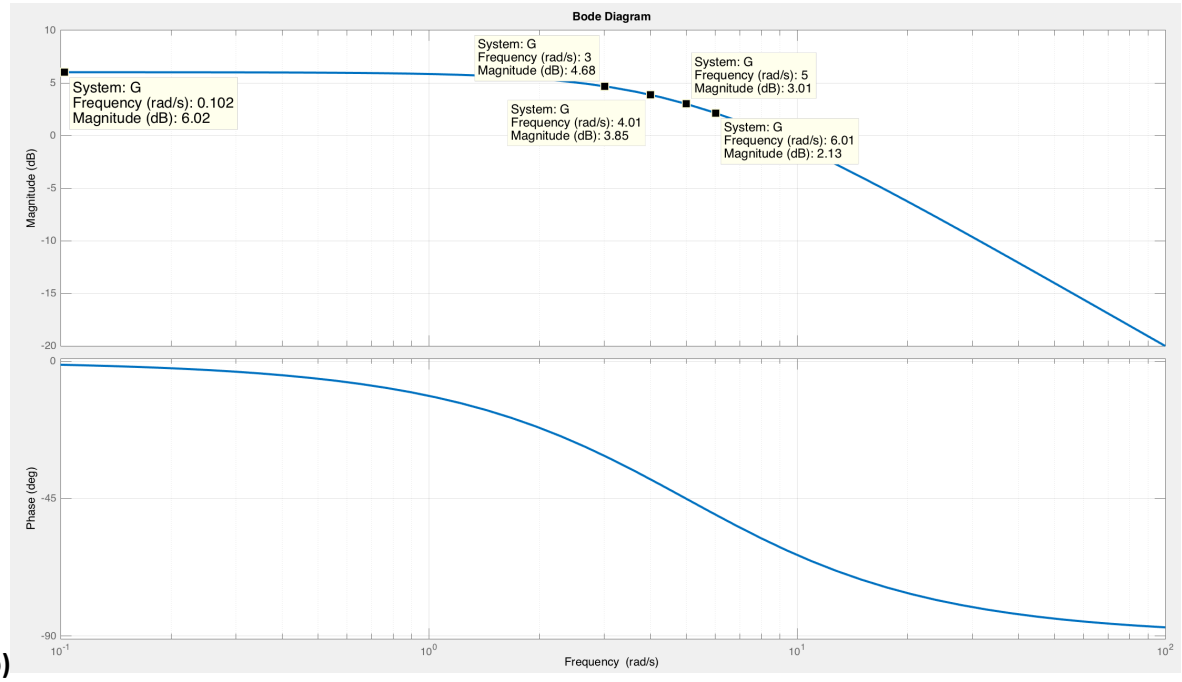
Date: February 24, 2020

Problem-1: Estimate the transfer function that produces the following Bode plots.

Solution-1



(a)



(b)

Figure 1. (a) The Bode plots for **Problem-1**, **(b)** their enlarged version with particular magnitude and frequency values.

Problem-2. Considering the feedback system on the right,

- **(a)** Sketch the Bode magnitude and phase plots of the open-loop transfer function with asymptotes on the logarithmic planes provided.
- **(b)** Write the slopes of each asymptotes on the plots.
- **(c)** Calculate the correction value in dB and show it on the magnitude plot for the underdamped components.

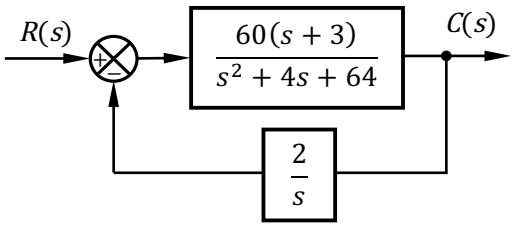


Figure 2. The closed-loop control system for **Problem-2**.

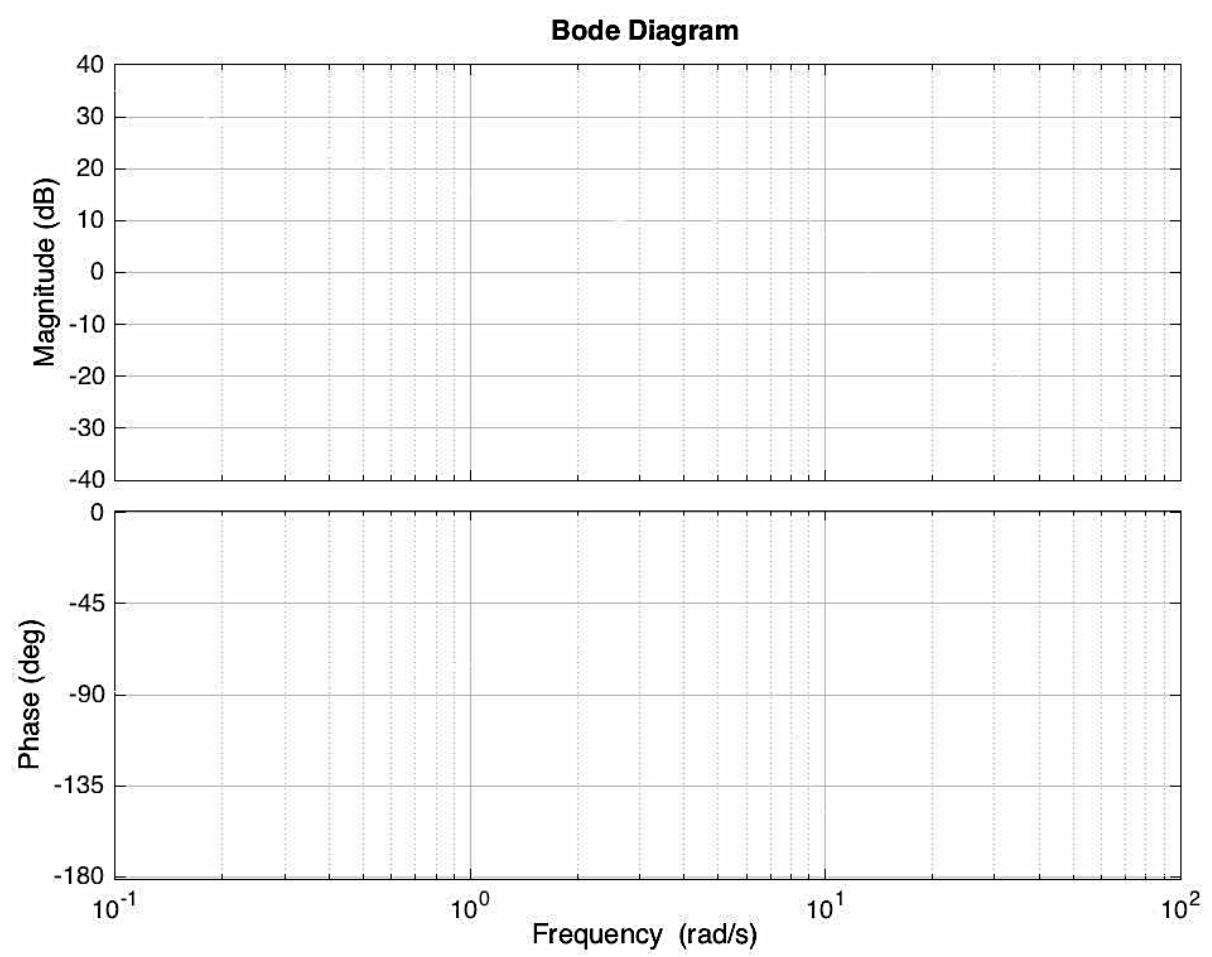


Figure 3. Logarithmic planes for **Problem-2**. You may change the values given in *x* and *y*-axes.

Solution-2:

- **(a)** On the plane
- **(b)** On the plane
- **(c)** …

Problem-3. From the Bode plots below, which was obtained from an open-loop system,

- **(a)** Estimate the Gain Margin and Phase Margin of the closed-loop system.
- **(b)** Determine the stability range of the closed-loop system supposing that the plots are obtained for $K = 5000$;
- **(c)** Write the gain that makes the system marginally stable.
- **(d)** Write the frequency of oscillation in rad/s and Hz when the system produces sustained oscillations.
- **(e)** What is the system type? Why?
- **(f)** Estimate the appropriate static error constant and corresponding steady-state error.

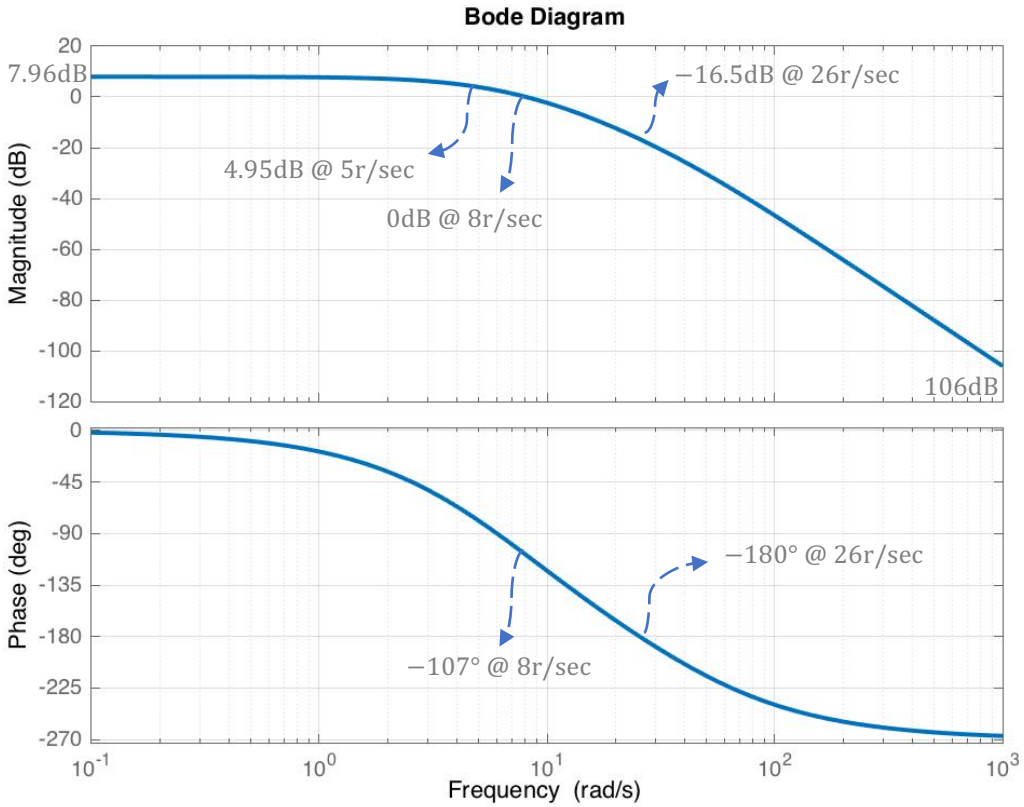


Figure 4. The Bode magnitude and phase plots for **Problem-3**.

Solution-3:

(a) …

Problem-4. Suppose that the Nyquist diagram on the right is drawn for an open-loop stable transfer function of a feedback control system when the gain is $K = 120$.

(a) Find the range of gain K for stability using the Nyquist criterion.

(b) Find the Gain Margin in dB.

(c) What would be the value of gain to get a gain margin of 20dB?

(d) What would be the real-axis crossing values at that gain?

(e) What is the value of gain making the system marginally stable?

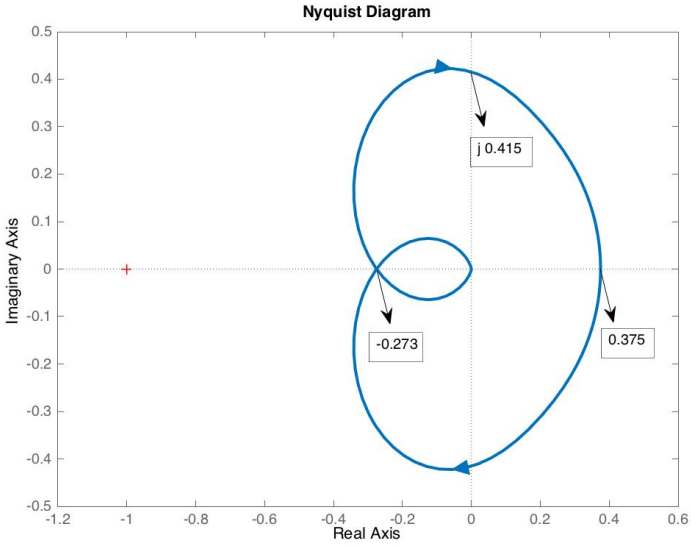


Figure 5. The closed-loop control system for **Problem-2**.

Solution-4:

(a) …