MAE143 B - Linear Control - Spring 2020
Final, June 11th

Instructions:

1. You have 50 minutes to complete this assignment.
2. Scan and submit your work on Gradescope as you did with homework.
3. Submission on Gradescope will open 45 minutes after the start of this exam and will remain open for 10 minutes.
4. You are only allowed to scan your homework during the Gradescope submission period.
5. If you have a connectivity problem during submission just email me your work.

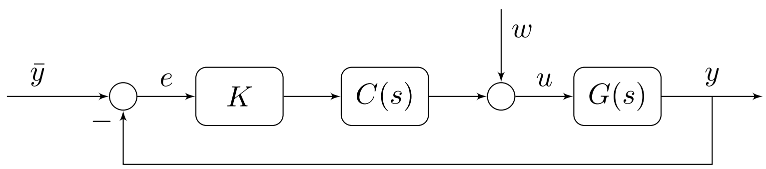

Figure 1

1. **Feedback Analysis and Design I.**

   Consider the feedback diagram in Fig. 1 in which

$$G(s) = \frac{s+100}{s-10}, \qquad C(s) = 1, \qquad L(s) = C(s)G(s), \tag{1}$$

   and answer the following questions:

   (a) (4 points) Use a root-locus diagram to determine whether it is possible to design a gain $K > 0$ that is capable of asymptoptically stabilizing the feedback loop.
   Hint: No need to calculate a value of K, only justify whether one is possible or not.

   (b) (1 point (bonus)) Calculate the range of values of $K > 0$ for which the feedback loop is asymptotically stable.

   (c) (2 points) Sketch the straight line approximation of the magnitude of the Bode plot of $L(s)$.
   Annotate your sketch with enough information!

   (d) (2 points) Sketch the straight line approximation of the phase of the Bode plot of $L(s)$.
   Annotate your sketch with enough information!

   (e) (2 points) Sketch the Nyquist diagram for the loop transfer-function $L(s)$.

   (f) (1 point (bonus)) Use the Nyquist stability criterion to determine whether it is possible to design a gain $K > 0$ that is capable of asymptoptically stabilizing the feedback loop.

2. **Feedback Analysis and Design II.**

   Repeat Problem 1 for the same $G(s)$ and

$$C(s) = \frac{s+1}{s} \tag{2}$$