Quiz

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1. (10pt) Plot the Bode diagram for the plant

$$G(s) = \frac{20(s^2 + s + 0.5)}{s(s+1)(s+10)}$$

2. (10pt) Consider the transfer function

$$G(s) = \frac{sT}{1 + sT}$$

   (a) Plot the Nyquist plot of this transfer function. (3pt)

   (b) Prove it is a circle. (4pt)

   (c) What is the circle center? What is its radius? (3pt)

3. (10 pt) A unity feedback control system has the following open-loop transfer function:

$$G(s) = \frac{K}{s(s+1)(s+2)}.$$

   (a) Plot the Bode plot of this system. (1pt)

   (b) Plot the Nyquist plot for this system. (1pt)

   (c) For what value of the Gain K does the closed-loop system go unstable? (4pt)

   (d) Pick a value of K such that the phase margin is 45 degrees. (2pt)

   (e) What is the resulting system bandwidth? (2pt)

4. (10pt) Consider a plant whose transfer function is

$$G(s) = \frac{1}{s^2 + 1}.$$

   the following characteristics are desired:

- Perfect reference input tracking at DC,
- Controlled system bandwidth above 6 rad/sec,
- 60 degrees phase margin.

Design a compensator that satisfies all these constraints. Write down your approach explicitly!