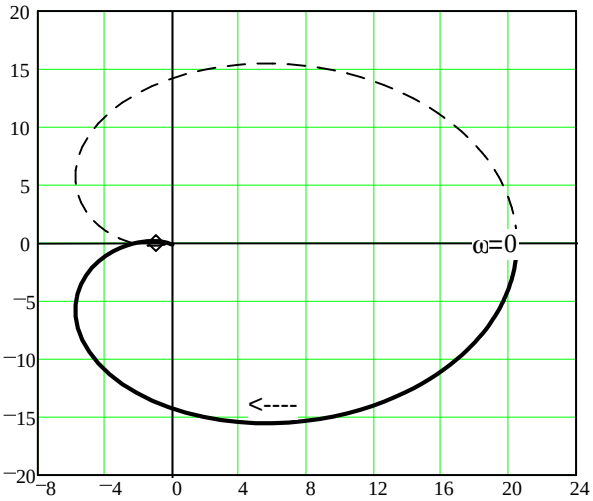
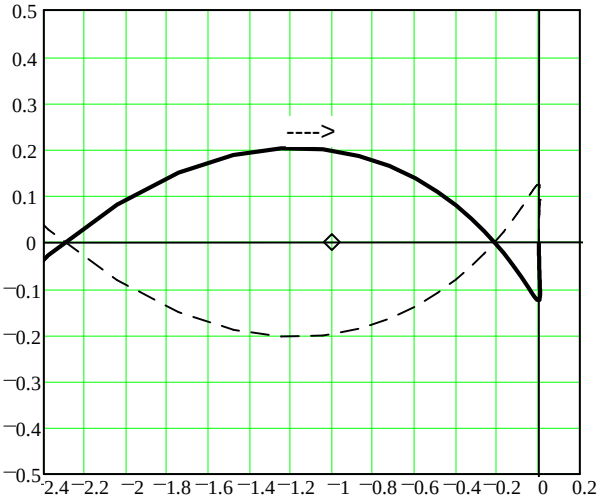
Name: _____ ECE 3510 homework Nq1

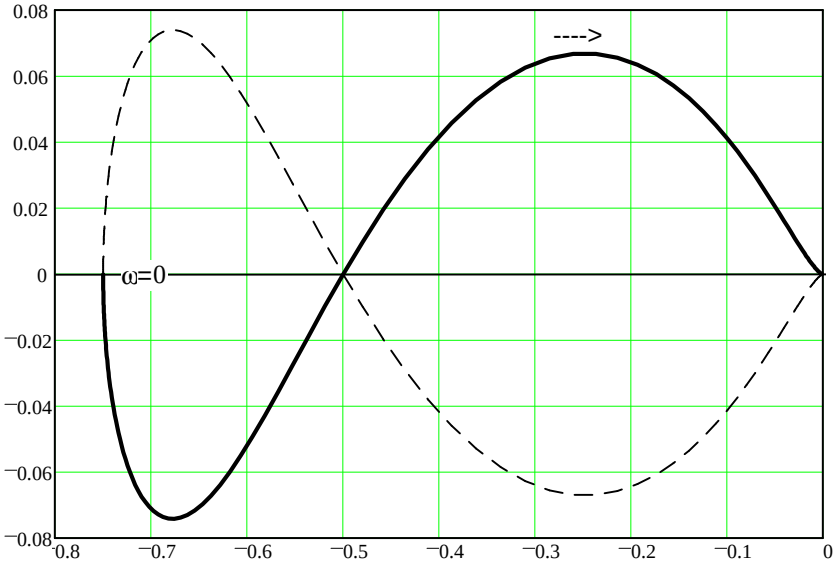
b

1. Similar to problem 5.4 in Bodson text.
   a) The Nyquist diagram of a stable system is shown below (or in text), with the overall diagram shown on the left and the detail around the (-1,0) point shown on the right. The solid line corresponds to $\omega > 0$, with the arrow giving the direction of increasing ω. The dashed line is the symmetric curve obtained for $\omega < 0$. Assuming that the transfer function of the system is multiplied by a gain $k > 0$, what is the set of values of k for which the system is stable in closed-loop?



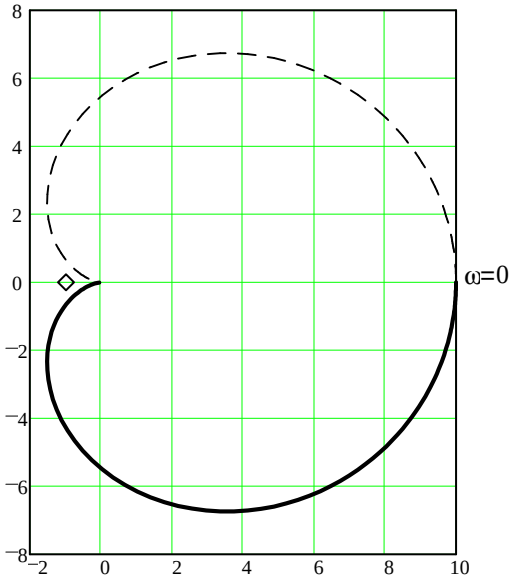


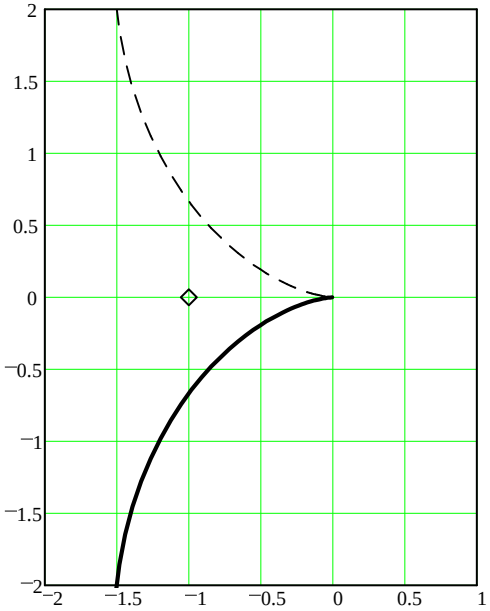
   b) Repeat part (a) for the system whose Nyquist curve is shown at below (or in text), given that the system has one unstable pole.



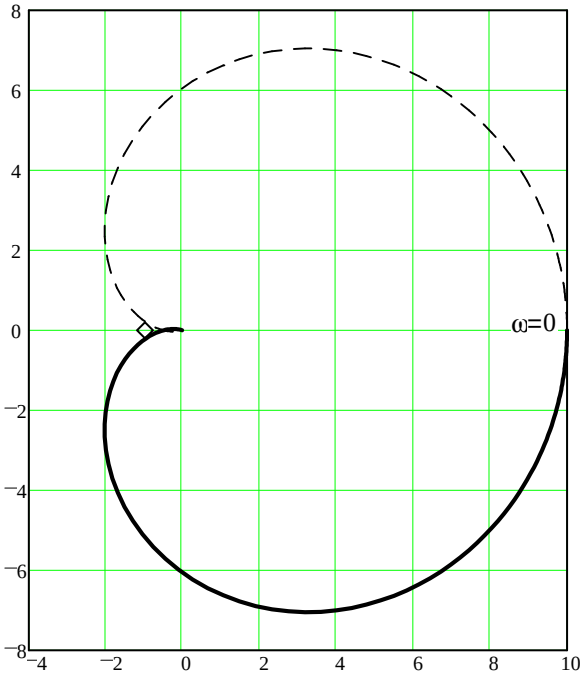
2. Problem 5.5 in Bodson text.

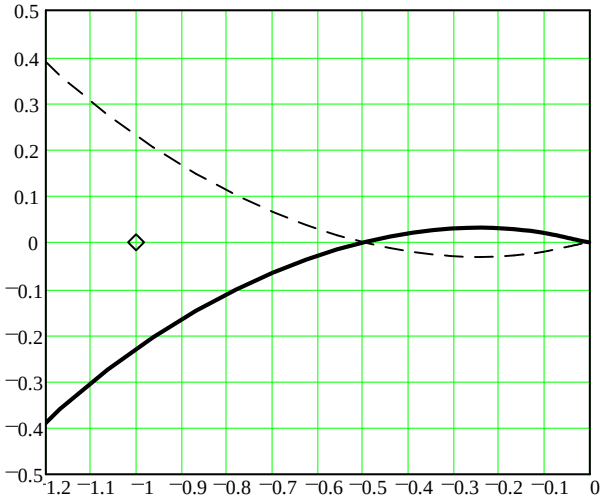
a) The Nyquist diagram for $P(s)=5(s+2)/(s+1)^3$ is shown below (or in text), with the overall diagram shown on the left and the detail around the (-1,0) point shown on the right. Indicate what the gain margin and the phase margins are (for the phase margin, show work on the drawing below). Compare the gain margin results with those predicted by a root-locus plot or the Routh-Hurwitz criterion.





b) Repeat part (a) for $P(s)=2(s+5)/(s+1)^3$ and the diagrams shown below.





Answers

1. a) $k < 0.435$ or $k > 5$ b) $\frac{4}{3} < k < 2$

2. a) GM = ∞ PM = 30·deg
   b) GM = 2 PM = 12.2·deg GMs may be confirmed by either root-locus or Routh-Hurwitz

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