

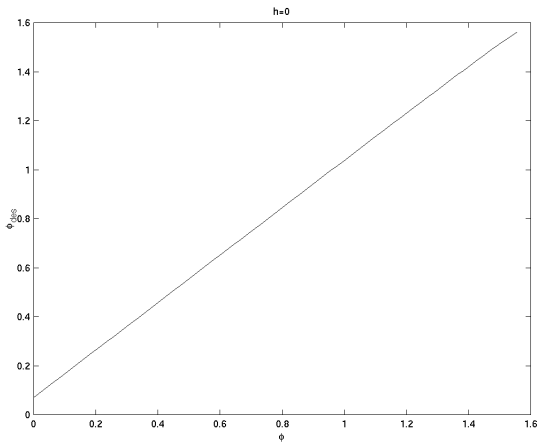
EE752 HOMEWORK #5 SOLUTIONS

Problem1

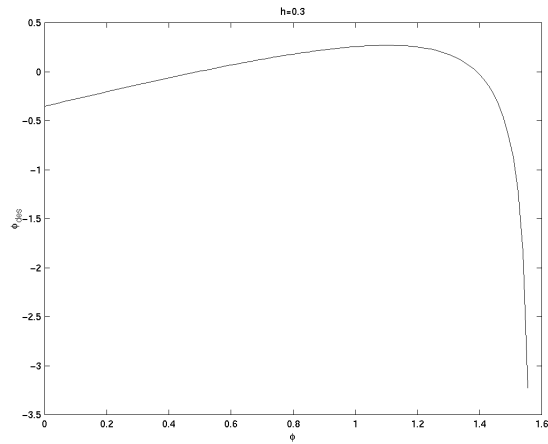
The plant is given as:
$$G(s) = \frac{2e^{-hs}}{s(s+0.1)}$$

The following three plots, phase margin vs. ϕ desired, are obtained for $h=0; 0.3; 0.5$ successively. Maximum phase margins are obtained as follows:

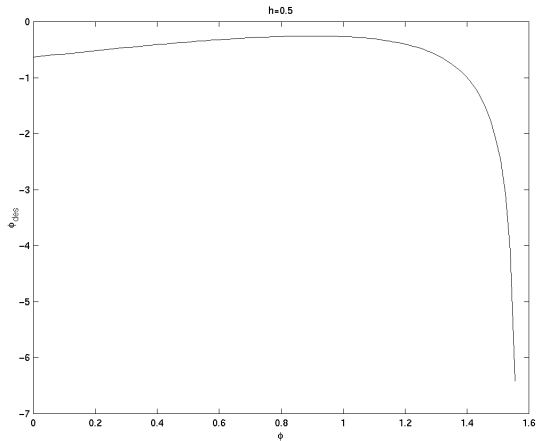
$h=0$	Phase margin max.= 89.4591°
$h=0.3$	Phase margin max.= 15.3883°
$h=0.5$	Phase margin max.= -14.6364°



$h=0$



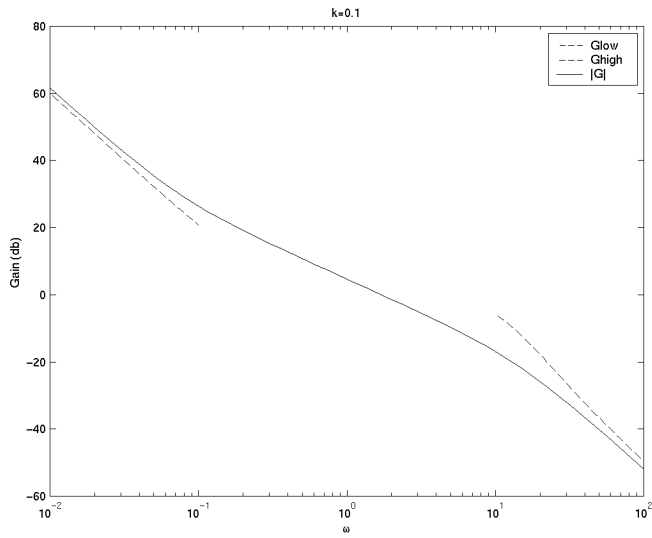
$h=0.3$



$h=0.5$

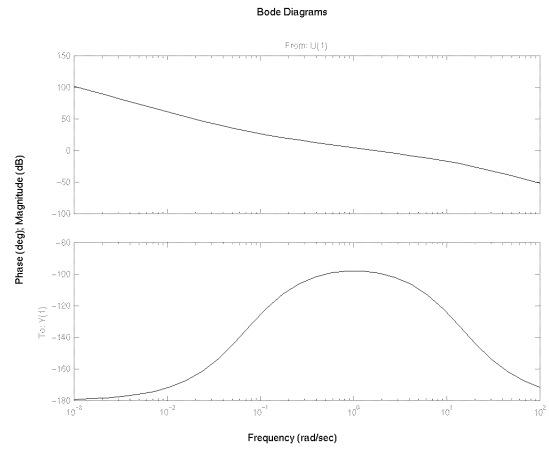
Problem 2

a-)

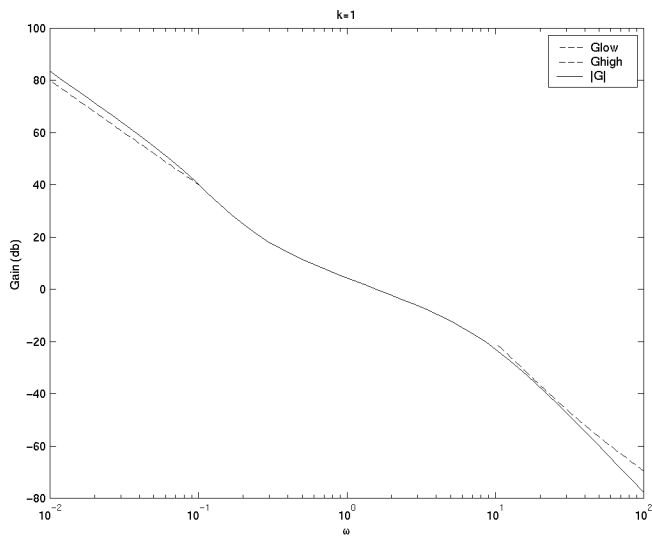


k=0.1

$$G(s) = 0.12 \frac{(s/0.07 + 1)}{s^2 (s/15 + 1)}$$

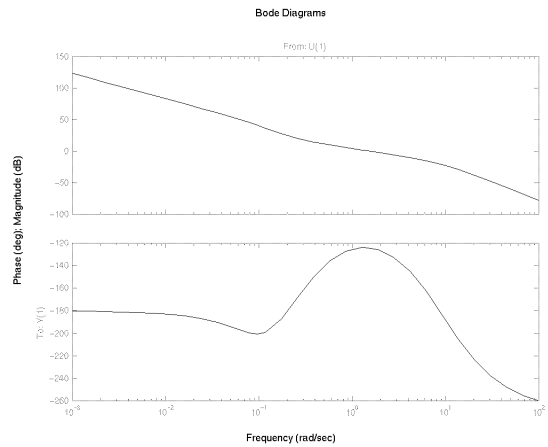


Pm=81.1648°

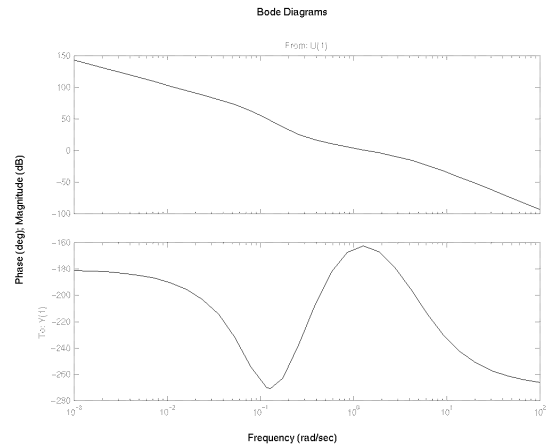
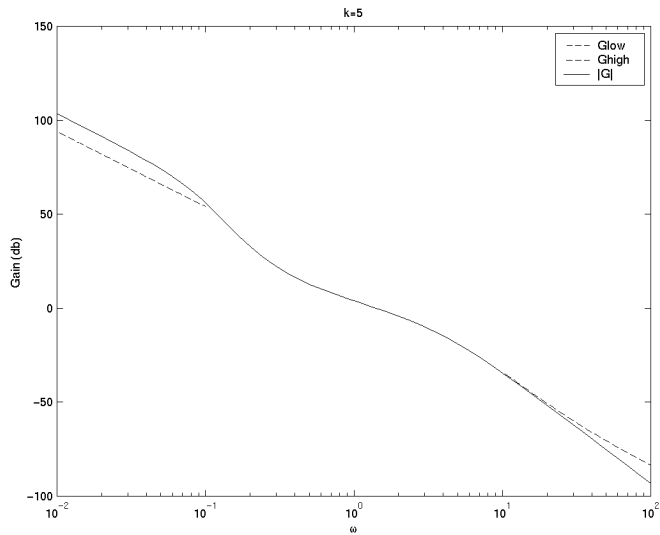


k=1

$$G(s) = 1.5 \frac{(s/0.15 + 1)^4}{s^2 (s^2/0.09^2 + 1.5/0.09s + 1)(15s + 1)(s/9 + 1)^2}$$



Pm=55.7139°



k=5

$$G(s) = 15 \frac{(s/0.11 + 1)^2 (5s + 1)^5}{s^2 (s^2/0.09^2 + 1.5/0.09s + 1)(s/0.09 + 1)(15s + 1)(s/3.8 + 1)^2}$$

Pm=17.3342°

As K increases the upper bound goes down, and the lower bound goes up. The problem becomes more difficult and the phase margin decreases.

b-) Each parameter in the system has 3 choices, if we plot all the combinations the following figure is obtained.

