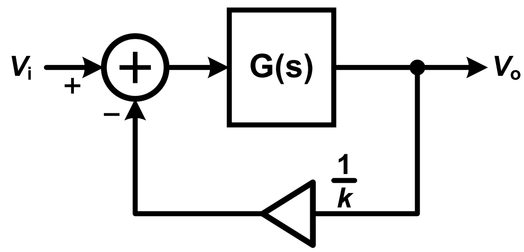
Homework 2

ECE 504 − PLL and High-Speed Link Design

Problem 1- **Feedback System Stability**

A feedback system representative of a PLL is shown below, where $G(s)$ is the forward-path transfer function and the feedback gain is given by $H(s) = \frac{1}{k}$.



1. For each the following systems, plot- (i) loop-response (magnitude and phase), (ii) closed-loop response, and (iii) closed-loop transient step-response. Also, label the parameters $\omega_{u,loop}$, ω_{3dB}, phase and gain margins (PM and GM), closed-loop DC gain (A_{CL}).

   (a) $G(s) = \frac{10^3}{s}$, $k = 1,\ 10$ (*Type-I system*)

   (b) $G(s) = \frac{10^3}{\left(1+\frac{s}{10^3}\right)\left(1+\frac{s}{10^4}\right)}$, $k = 1,\ 10$ (*two close poles*)

   (c) $G(s) = \frac{10^3}{\left(1+\frac{s}{10^3}\right)\left(1+\frac{s}{10^6}\right)}$, $k = 1,\ 10$ (*two separated poles*)

   (d) $G(s) = \frac{5\times10^8}{s^2}$, $k = 1,\ 10$ (Type-II system)

   (e) $G(s) = \frac{5\times10^8\left(1+\frac{s}{10^3}\right)}{s^2}$, $k = 1,\ 10$ (Type-II system with a zero)

   (f) $G(s) = \frac{5\times10^8\left(1+\frac{s}{10^3}\right)}{s^2\left(1+\frac{s}{10^6}\right)}$, $k = 1,\ 10$ (Type-II system with a zero and a pole)

2. Comment on the stability of the above systems in a closed loop. Do you observe any relation between the PM and the settling response?

PS: Make sure you spend some effort in arranging and illustrating the plots instead of just copy-pasting the plots in the document.