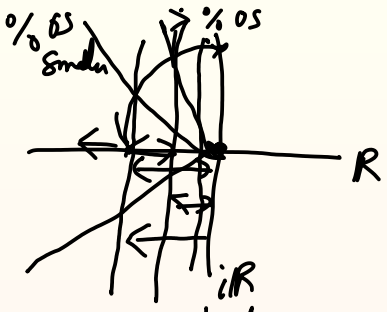
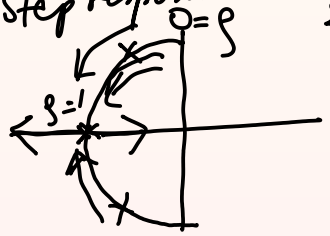
2nd order system

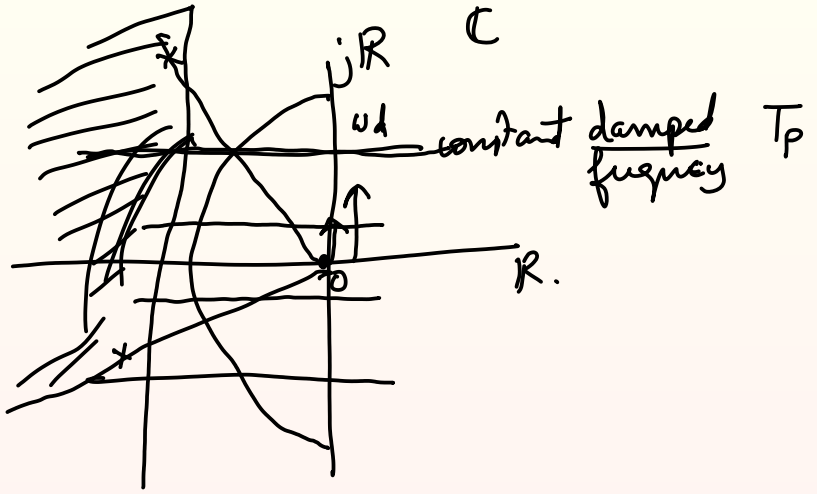
$$\frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2} = G(s)$$

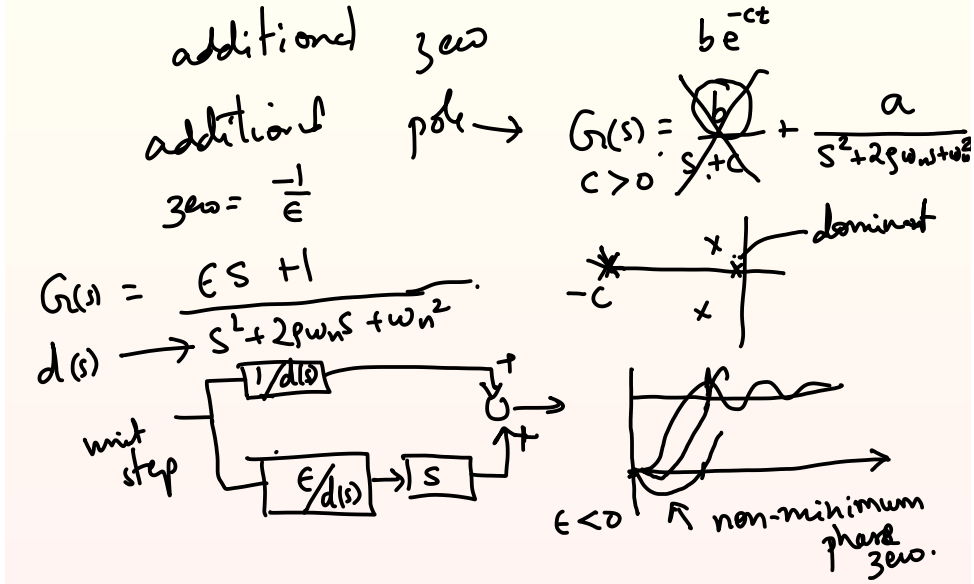


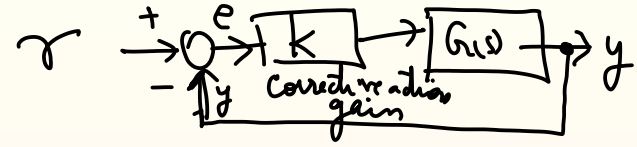
Constant 2% settling

unit step → G(s) → step response




C
jR
ω_d
constant
damped
frequency
T_p
R.


additional zero
additional pole
zero = $\frac{-1}{\epsilon}$
be^{-ct}
$G_1(s) = \frac{b}{s+c} + \frac{a}{s^2+2\zeta\omega_n s+\omega_n^2}$
$c > 0$
dominant
$-c$
$G_2(s) = \frac{\epsilon s + 1}{s^2+2\zeta\omega_n s+\omega_n^2}$
$d(s)$
$1/d(s)$
$\epsilon/d(s)$
s
unit step
$\epsilon < 0$
non-minimum phase zero.

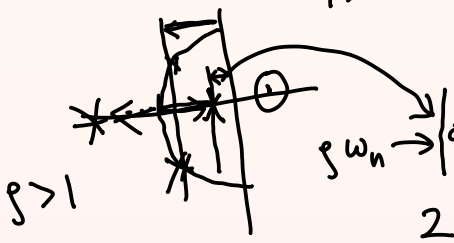


$\in$ RHCP

non-minimum phase zero

$\Downarrow$

instability in closed loop for large gain



2% settling time.