EIE3123 DYNAMIC ELECTRONIC SYSTEMS: QUIZ 3

OS% = 10%

Tp = 0.6s

Damping ratio = -ln(0.1)/ √(π2 + ln(0.1)^2)

= 0.59116

Phase margin = tan-1(2(0.59116)/ √( (-2(0.59116^2)+ √( (1+4(0.59116^4))))

= 58.593

Closed-loop Bandwidth = π/0.6\*√(1-0.59116^2) \* √((1-2(0.59116^2))+

√(4(0.59116^4)-4(0.59116^2)+2))

= 7.5299 rad/s

Closed-loop Bandwidth =

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Bode plot of G(s)

Chart

Description automatically generated

From the Bode diagrams, the uncompensated system has a phase

margin of 34.411 and a phase-margin frequency of 7.21842 rad/s

Select ω­max = 5 rad/s as the new phase-margin frequency.

At this frequency, the uncompensated phase = 48.53

Thus, the required phase contribution from the lead compensator is:

58.593 –(48.53-10) = 20.063

Β = (1 – sin20.063) /(1 + sin20.063) = 0.4891

//Lag

Choose the lag compensator’s higher break frequency to be 1 decade below the new phase-margin frequency (0.5 rad/s)

the transfer function of the lag compensator is:

GLag(s) = 0.4891\*((s + 0.5)/(s + 0.24455))

//Lead

Using ωmax = 5 rad/s,

1/T = 5/(1/(√(Β)) = 3.49678

GLead(s) =2.04457\*((s + 3.49678)/(s + 7.1494))

Unit step response of the lag-lead-compensated system: Chart, line chart

Description automatically generated

By adjusting the gain by 1.05, K = 2520,

Unit step response of the lag-lead-compensated system:

Chart, line chart

Description automatically generated

The percentage overshoot is 11% and the settling time is 0.45 second.