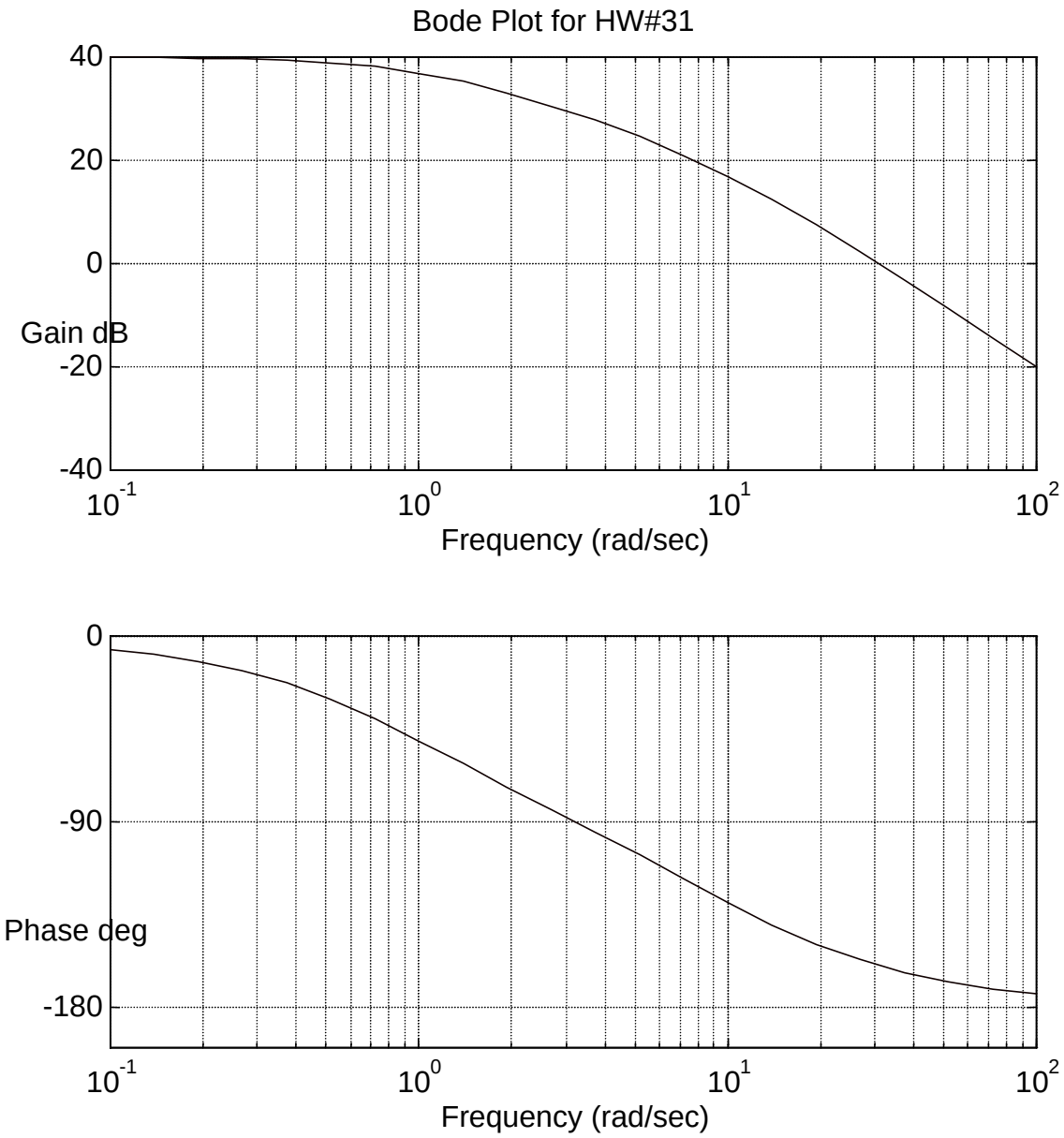
1. a) From the Bode Plot below, find G(s), the open-loop transfer function (assume H(s)=1)



b) For the system in part b), find $ess|_{step}$ and $ess|_{ramp}$, the gain cross-over frequency (ω_{cg}), the phase cross-over frequency (ω_{cp}), the gain margin (gm) and the phase margin (pm).

c) Design a lead compensator of the form, $G_{lead}(s) = K_c(s)(Ts+1)/(\alpha Ts+1)$, such that the compensated system satisfies the following specifications:

i) gm > 5 dB
ii) pm about 30^o
iii) $ess|_{ramp} = 1/25$

d) Repeat part c) using a Lag compensator design

2. Consider the lead compensator when $K_c=1$ (i.e., $G_{lead}(s) = (Ts+1)/(\alpha Ts+1)$).

a) If ϕ_m is the maximum lead angle the compensator can supply, derive an expression for ϕ_m in terms of α

b) Derive an expression the frequency, ω_m, at which this maximum occurs (i.e, find where $\angle G_c(j\omega_m) = \phi_m$)

c) Derive the additional gain produced by the compensator at this frequency (i.e., find $|G_c(j\omega_m)|$)