ECE311

Design Project: Part 2b

Aim: In Project Part 2a an integral controller was designed using the Routh-Hurwitz criterion which gave a range of *K* values, i.e. the integral gain, for which the system was stable. Now in Part 2b we will approach the design of an integral controller using the Bode plot method discussed in class and presented in T&R. This will result in a specific value of *K* being chosen which will satisfy the phase and gain margins requirements, whilst maximizing loop bandwidth. The response to a step input will be examined in PECS (the circuit level simulator).

Tasks:

An integral controller has a transfer function: $G_C(s) = \frac{K}{s}$, *K* is the parameter to be designed. The Bode plot process for designing an integral controller for a Buck regulator is detailed in T&K. It was also looked at in the HW6. In a nutshell the process may be described as follows. The asymptotic magnitude and phase responses of the compensated loop gain is drawn. This is then annotated with values or simplified expressions for the magnitude and phase segments. Based on requirements of phase and gain margins the value of *K* may be easily determined.

Deliverables

In your report do not copy any figures from T&R. Your own computer generated or neatly hand drawn asymptotic gain and phase plots are required.

1) Provide annotated asymptotic magnitude and phase plots of the compensated loop gain.
2) Requiring a phase margin ≥ 60 degrees and gain margin ≥ 10 dB, while maximizing loop gain bandwidth, determine the equations using the asymptotic plots that may be used to design *K*. Show these equations and subsequently determine *K*.
3) Using the obtained value of *K* show the design of the circuit implementation of the compensator.
4) Show the closed loop PECS schematic.
5) Show the step response to a 10% step in the input voltage obtained from PECS.
6) Determine the % overshoot and the 5% settling time.
7) Using the Matlab '*margin*' command show the loop gain plot of the compensated system.
8) Compare your designed values of phase and gain margin with that obtained from the *margin* command.

The above can be provided in about 4-5 pages. There is no need for embellishments.