1. Problem 8.10

2. Draw the frequency-domain magnitude boundaries which the loop gain function must avoid in order to meet the following simultaneous specifications:

- Steady-state error to a step input: 5%
- Follow commands with a maximum of 10% error, where the commands have frequency content up to 3 rad/sec.
- Attenuate noise to 10% of the value measured at the sensors, at frequencies of 250Hz and above.
- Maintain the above specifications for an error in the plant dynamics whose magnitude is bounded by:

\[ \text{Error}(s) < \frac{s + 50}{1000} \]

(NOTE: Do not consider a closed-loop stability specification here)

Draw an asymptotic magnitude Bode plot that meets these specifications.

3. Problem 8.11 - - Do this problem by hand - - do not use Matlab or any other computer tools.

4. Problem 8.21 - - Use Matlab for this problem.
5. In some aerospace applications, the vehicle open-loop dynamics exhibit so-called ‘droop’ in the closed loop performance when feedback is applied. Droop is when the closed-loop command following is poor in the low- and the mid-frequency ranges, and high-frequency considerations make this problem difficult to remedy. This problem investigates these issues. Consider:

\[
G(s) = \frac{(s + 10)}{(s + 100)(s^2 + 10s + 40^2)}
\]

Using Matlab, design a compensator that achieves less than 10% error in command following for signals with frequency content up to 0.5 rad/sec – extend this frequency range if possible, and try to minimize the droop in the range of frequencies from 0.5 to 10 rad/sec. Your design must remain stable if a 0.01 second time delay is added to the dynamics (for instance, due to a 50 Hz digital implementation). Plot the following:

1) Bode plot of your design, with all compensator poles labeled;
2) Closed-loop Bode plot, indicating frequency range over which the specification is met, as well as maximum droop in dB;
3) Closed-loop unit step response of your design (do not include time delay in this design). How does droop manifest itself in this plot?