1. **(30 Points)** Several studies have proposed an extravehicular robot that could move around in a NASA space station and perform physical tasks at various worksites. The arm is controlled by a unity-gain negative feedback control with open loop transfer function

\[
L(s) = C(s)G(s) = \frac{k}{s(s/5 + 2)(s/100 + 1)}.
\]

Sketch the Bode diagram for \( K = 20 \), and determine the frequency \( \omega \) such that \( |L(j\omega)|_{dB} = 0_{dB} \).

2. **(70 Points)** Consider the system \( G(s) = \frac{1}{s^2} \). Design a controller that guarantees a settling time (with a 2% criterion) \( T_s \leq 4 \text{ sec} \), and a percent overshoot for a step input \( \leq 35\% \).

Remember that for a transfer function of the form \( G(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_ns + \omega_n^2} \), the following formulae hold:

\[
t_r = \frac{\pi - \beta}{\omega_n\sqrt{1-\zeta^2}} \quad t_p = \frac{\pi}{\omega_n\sqrt{1-\zeta^2}} \quad M_p = e^{-\frac{\zeta}{1-\zeta^2}^{\frac{\pi}{\zeta}}} \quad T_s(2\%) = \frac{4}{\zeta\omega_n}
\]

which provide the rise time, peak time, maximum overshoot, and settling time, respectively, and \( \beta \) is such that \( \cos(\beta) = \zeta \).