題號： 229　　國立臺灣大學 109 學年度碩士班招生考試試題

科目： 控制系統(A)

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1. Sketch the Bode plot for the following systems, mark the gain (in dB) and phase (in degrees) values at the low frequency and high frequency range, the slope of descent/ascend, the damped resonance frequency, and the resonance peak value if any.

   (a) (5%) $G(s)=\frac{50}{s+5}$ (b) (5%) $G(s)=\frac{40(s-10)}{s^2+4s+400}$.

2. Consider the system $G(s)=\frac{40(s-10)}{s^2+4s+400}$,

   (a) (5%) Find out the steady state value of a step response.

   (b) (5%) Draw the Nyquist plot of the system.

   (c) (10%) Use the Nyquist stability theorem to derive the stability range for a positive constant gain feedback, K.

   (d) (10%) Notice that the closed-loop system is still stable when $K=-0.03$. Please explain the situation with the Nyquist stability criterion?

3. (10%) For the system $G(s)=\frac{40(s-10)}{s^2+4s+400}$, it is noted that using a positive feedback $G_c(s)=-\frac{1}{s}$ can stabilize the system with no steady state error. Please draw the frequency response of the system and determine the phase margin and gain margin of the system.

4. (10%) Please compare the PD control with the phase-lead control in terms of advantages, disadvantages, and applications.

5. (20%) Consider a unity-feedback system with the forward-path transfer function as $G(s)=\frac{4500K}{s(s+360)}$. Design a PD controller based on root locus to satisfy the following constraints:

   Steady-state error due to unit-ramp input =0.00044

   Maximum overshoot $\leq 5\%$

   Rise time $t_r \leq 0.005\,\text{sec}$

   Settling time $t_s \leq 0.005\,\text{sec}$

6. (20%) Given the system $G(s)=\frac{1}{s(s+1)(s+3)}$,

   (a) Find the corresponding state space representation,

   (b) Can you design a state feedback control to place the closed-loop poles at -1+j and -1-j? if yes, find the third root and the state feedback gains.

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