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國立臺北科技大學 106 學年度碩士班招生考試

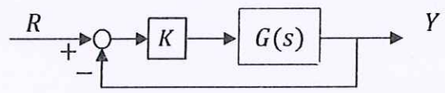
系所組別：1302 車輛工程系碩士班

第二節　自動控制　試題　（選考）

注意事項：

1. 本試題共三題，共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

一、 For a unit feedback system as shown below, please describe how to analyze the stability using 1. Routh criterion (10%), 2. Root locus (10%), 3. Bode plot (10%), and 4. Nyquist plot (10%).



二、 A servomechanism position control has the plant transfer function

$$G(s)=\frac{5}{s(s+1)(s+10)}$$

You are required to design a lead compensator for the unity feedback configuration using the **frequency-response design**. The following closed-loop specifications are required to be satisfied.

- The response to a reference step input is to have no more than 10% overshoot.
- The response to a reference step input is to have a rise time of no more than 0.9 sec.

1. What is the phase of $G(s)$ at the desired crossover frequency? (5%)
   [Hint: You might need to use one of the following information:
   $G(s)|_{s=0.2j}=-0.5286-2.3933j$ *or* $G(s)|_{s=2j}=-0.1058-0.0288j$
2. In order to satisfy the phase margin requirement at the desired crossover frequency, how should you design the lead compensator $D_1(s)=K\frac{T_1s+1}{\alpha_1T_1s+1}$? (20%)
3. After we obtain the lead compensator, how should you design the lag compensator $D_2(s)=\alpha_2\frac{T_2s+1}{\alpha_2T_2s+1}$ such that the steady-state error with respect to the ramp input is less than 1%? (10%)
4. What is the minimum time delay to destabilize the system? (5%)

三、 For a plant transfer function as shown below,

$$G(s)=\frac{1}{s(s+1)}$$

You are required to design a lead compensator for the unity feedback configuration using the **root-locus design**. If the desired closed-loop complex poles are placed at $-3.5\pm j3.5\sqrt{3}$, and the lead pole is placed at -20 due to the noise suppression requirement, please design a lead compensator $D(s)=K\frac{s+z}{s+p}$. (20%)