國　立　清　華　大　學　命　題　紙

九十三學年度 工程與系統科學 系（所） 丁 組碩士班入學考試

科目 控制原理 科號 4104 共 1 頁第 1 頁 *請在試卷【答案卷】內作答

1. Consider the unity-feedback system shown below, where W is the disturbance.

The proportional, integral, derivative, or their combination are adopted as controller, D(s), which should be as simple as possible. You are requested to fulfill the design requirement. Based on the control theory, explain the reason to choose the specific type of controller and do some analysis to make sure the control system is proper.

(i) $G(s) = K/[s(s-p_1)(s+p_2)]$ and $p_2 > p_1 > 0$, improve the speed of response. (15%)

(ii) $G(s) = K/[s(s+p_1)(s+p_2)]$ and $p_1, p_2 > 0$, achieve zero steady state error with respect to both constant R and W. (10%)

2. The open-loop transfer function of certain unity-feedback control system is given below. Discuss the stability of the closed-loop system as a function of $K > 0$. Determine the values of K which will cause sustained oscillations in the closed-loop system. What is the corresponding oscillation frequency? (15%)
$G(s) = K(s+1)/[s(s-1)(s^2+4s+16)]$

3. For the open-loop transfer function F(s) given below, sketch the general shape of the root locus plot of the characteristic equation $1 + F(s) = 0$, as the gain K is varied from 0 to∞. (20%)
$F(s) = K(s+1)/[s^2(s+9)]$

4. Consider unity-feedback system with open-loop transfer function
$G(s) = K(s-1)/[s^2(s+1)(0.5s+1)]$
   (i) Approximately plot the Bode plots for $K = 1$. (7%)
   (ii) Plot the corresponding Nyquist plots. (7%)
   (iii) What is the number of unstable poles for various values of K? (6%)

5. (i) When you design a lead compensator on the Bode plots, how do you choose the new gain crossover frequency so that the maximum phase can be achieved? (10%)
   (ii) If the phase angle of the uncompensated system decreases rapidly near the gain crossover frequency, which compensation, lead or lag, is more effective assumed that the bandwidth is not concerned? Why? (10%)