

國立臺灣科技大學
九十三學年度博士班考試試題

系所組別：電子工程系乙組
科 目：控制系統

總分 100 分

1. For a general 2nd-order system $G(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$, where $\zeta < 1$, please

show that the overshoot of its unit step response is $OS = e^{-(\zeta\pi/\sqrt{1-\zeta^2})}$. (20 %)

2. Given a unity feedback system that has a forward transfer function, $G(s) = \frac{K(s+2)}{s^2 - 4s + 13}$, do the following: (40 %)

- (a) Sketch the root locus.
- (b) Find the imaginary axis crossing.
- (c) Find the gain, K , at the $j\omega$ axis crossing.
- (d) Find the break-in point (ie, multiple roots).

3. For a unity feedback system with a forward transfer function, $G(s) = \frac{K}{(s+2)(s+4)(s+6)}$, find the range of gain, K , for stability. Use the

Nyquist criterion. (20 %)

4. For a lead compensator with a transfer function, $G_C(s) = \frac{s + \frac{1}{T}}{s + \frac{1}{\beta T}}$, where $\beta < 1$,

please show that $G_C(s)$ gives a maximum phase angle $\phi_{\max} = \sin^{-1} \frac{1-\beta}{1+\beta}$ at a

frequency $\omega_{\max} = \frac{1}{T\sqrt{\beta}}$. (20 %)

