編號： 179

國立成功大學 107 學年度碩士班招生考試試題

系　　所：電機工程學系

考試科目：控制系統

考試日期：0205，節次：2

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Please derive the peak time T_p and the percent overshoot $\%OS$ for the step response of an underdamped second-order system, $G(s)=\dfrac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$, in terms of ζ and ω_n. (25%)

2. For the system represented in state space as follows:

$$\dot{\mathbf{x}}=\begin{bmatrix}-3 & 1\\ 1 & -3\end{bmatrix}\mathbf{x}+\begin{bmatrix}1\\ 2\end{bmatrix}u$$

$$y=\begin{bmatrix}2 & 3\end{bmatrix}\mathbf{x}$$

find the diagonal system that is similar. (25%)

3. Consider a closed-loop system described in Figure 1, where $C(s)=K$ and $G(s)=\dfrac{s+1}{s^3+\alpha s^2+5s+1}$. Please apply Routh-Hurwitz method to determine the value of K and α so that the system oscillates at a frequency of 2 rad/sec and no poles in the right half of the s-plane. (15%)

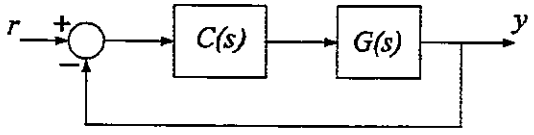

Figure 1

4. For a standard second-order system, $G(s)=\dfrac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$, please derive the bandwidth ω_{BW} of $G(s)$ in terms of ζ and ω_n. (15%)

5. Consider the following MIMO system,

$$\dot{\mathbf{x}}=\begin{bmatrix}5 & 1 & 0 & 0 & 0 & 0 & 0\\ 0 & 5 & 0 & 0 & 0 & 0 & 0\\ 0 & 0 & 5 & 0 & 0 & 0 & 0\\ 0 & 0 & 0 & 5 & 0 & 0 & 0\\ 0 & 0 & 0 & 0 & 8 & 1 & 0\\ 0 & 0 & 0 & 0 & 0 & 8 & 1\\ 0 & 0 & 0 & 0 & 0 & 0 & 8\end{bmatrix}\mathbf{x}+\begin{bmatrix}0 & 0 & 0\\ 1 & 0 & 1\\ 0 & 1 & 0\\ 1 & 1 & 2\\ 1 & 2 & 3\\ 0 & 1 & 1\\ 0 & 0 & 0\end{bmatrix}\mathbf{u}$$

$$y=\begin{bmatrix}1 & 1 & 0 & 1 & 1 & 2 & 1\\ 1 & 0 & 1 & 2 & 0 & 1 & 1\\ 1 & 2 & 2 & 3 & 0 & 2 & 0\end{bmatrix}\mathbf{x}$$

Please determine the controllability and observability of the eigenvalues 5's and 8's, respectively. (20%)