編號： 178

國立成功大學 106 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：0213，節次：2

第 1 頁，共 1 頁

※ 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. Find the transfer function $G(s) = I_2(s)/V_i(s)$ for the network shown in *Fig.* 1 using nodal analysis. (25%)

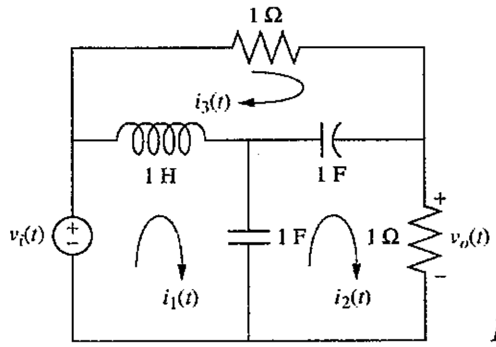

Fig. 1

2. Consider a closed-loop system described in *Fig.* 2, where $C(s) = K$ and $G(s) = \dfrac{(s+4)^2}{s^2(s-5)}$. Please apply Nyquist plot design method to find the range of K such that the closed-loop system is stable. (25%)

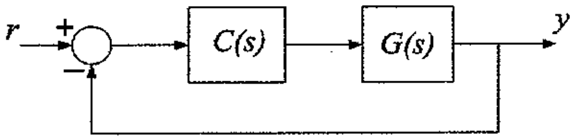

Fig. 2

3. Solve for the state transition matrix $\mathbf{\Phi}(t)$, the state vector $\mathbf{x}(t)$, and the output $y(t)$ of the following system using Laplace transform methods: (25%)

$$\dot{\mathbf{x}}(t) = \begin{bmatrix} 0 & 2 \\ -2 & -5 \end{bmatrix}\mathbf{x}(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} e^{-2t}; \quad y(t) = \begin{bmatrix} 4 & 2 \end{bmatrix}\mathbf{x}(t); \quad \mathbf{x}(0) = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

4. **Definition**: Consider $\dot{\mathbf{x}}(t) = \mathbf{A}(t)\mathbf{x}(t)$ where $\mathbf{A}(t)$ is $n \times n$ with continuous functions of t as its entries. An $n \times n$ matrix $\mathbf{Q}(t)$ is said to be a fundamental matrix of $\dot{\mathbf{x}}(t) = \mathbf{A}(t)\mathbf{x}(t)$ if and only if the n columns of $\mathbf{Q}(t)$ are linearly independent. Suppose $\mathbf{\Phi}(t, t_0) \equiv \mathbf{Q}(t)\mathbf{Q}^{-1}(t_0)$, then $\mathbf{\Phi}(t, t_0)$ is called the state transition matrix of $\dot{\mathbf{x}}(t) = \mathbf{A}(t)\mathbf{x}(t)$. Please prove that

(a) $\mathbf{\Phi}(t_0, t_0)$ is an identity matrix. (5%)

(b) $\mathbf{\Phi}^{-1}(t, t_0) = \mathbf{\Phi}(t_0, t)$ (5%)

(c) $\mathbf{\Phi}(t, t_0) = \mathbf{\Phi}(t, t_1)\mathbf{\Phi}(t_1, t_0)$ (5%)

(d) $\mathbf{\Phi}(t, t_0)$ is uniquely determined by $\mathbf{A}(t)$ and is independent of the chosen fundamental matrix. (10%)