

本試題是否可以使用計算機： 可使用， 不可使用 (請命題老師勾選)

1. (15%) Determine the transfer function $V_o(s)/V_s(s)$ of the OP-amp circuit shown in Fig. 1, in which $R_1 = 50 \text{ k}\Omega$, $R_2 = 20 \text{ k}\Omega$, $C_1 = 10 \text{ }\mu\text{F}$, and $C_2 = 5 \text{ }\mu\text{F}$.

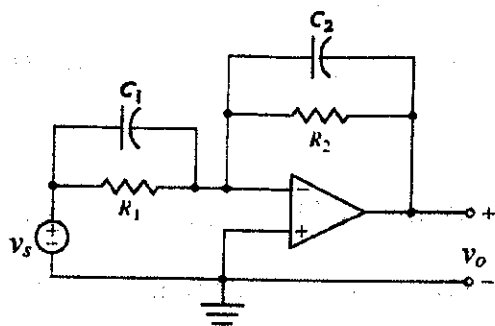


Fig. 1

2. (15%) Find the state transition matrix $\Phi(t)$ for a system described by the transfer function, $G(s) = \frac{10}{s^2 + 5s + 6}$.
3. (20%) A tape drive control system is shown in Fig. 2. (a) Determine the limiting gain K for a stable system. (b) Determine a suitable gain K so that the overshoot to a step command is approximately 3%.

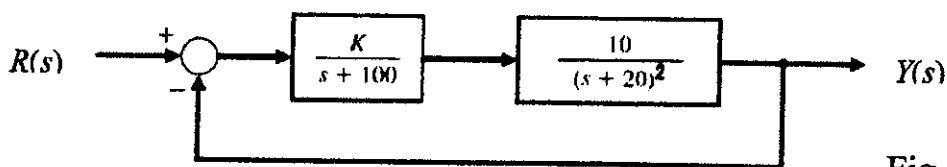


Fig. 2

4. (20%) Consider the Bode magnitude plot of a plant shown in Figure 3, where $|G(j0.1)| = 1$, $|G(j1)| = 10^{-4}$, $|G(j2)| = 0.36$, and no poles or zeros are located in the RHP. Please determine the transfer function $G(s)$.

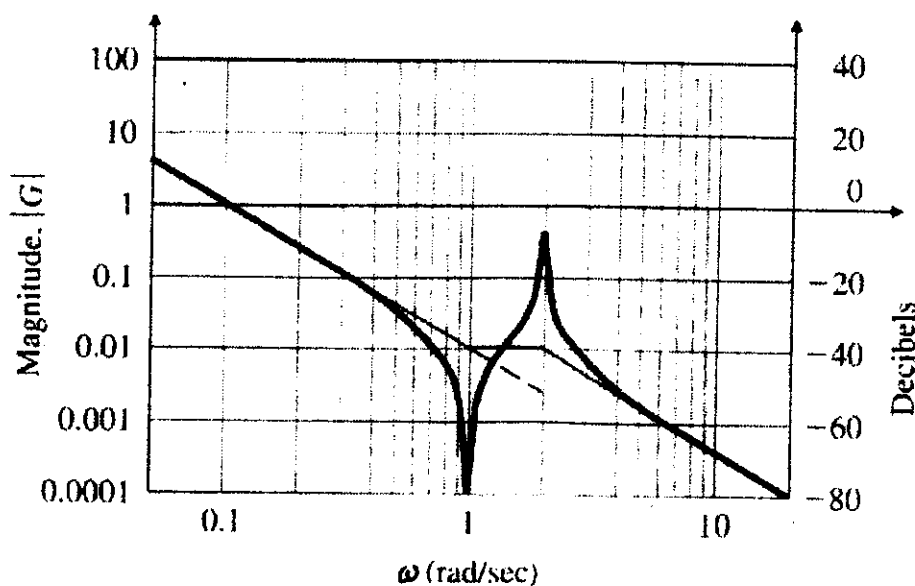


Fig. 3

(背面仍有題目,請繼續作答)

編號：F 246 系所：電機工程學系乙組

科目：控制系統

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5. (12%) Please check the controllability and observability of the linear time-varying

$$\text{system, } \dot{X}(t) = \begin{bmatrix} t & -1 & 0 \\ 0 & -t & t \\ 0 & 0 & t \end{bmatrix} X(t) + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u, \quad y = [1 \ 1 \ 0] X(t).$$

6. (18%) Consider a multivariable LTI system $\dot{x} = Ax + Bu$. Show that the n-dimensional pair (A, B) is controllable if the $n \times n$ matrix

$$W_c(t) = \int_0^t e^{A\tau} B B' e^{A'\tau} d\tau \text{ is nonsingular for any } t > 0.$$