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）　　　考試日期：0301，節次：2

1. (20%) Consider the Bode magnitude plot of a plant $G(s)$ shown in Figure 1, where no poles or zeros are located in the RHP. Please determine the transfer function $G(s)$ if $|G(j0.01)| = 50000$, $|G(j1)| = 0.1040$, $|G(j5)| = 45.1160$, $|G(j20)| = 0.0140$, and $|G(j100)| = 15.0360$.

2. (10%) For a standard 2nd-order system, the closed-loop transfer function is $F(s) = \dfrac{25}{s^2 + 2s + 25}$. Please derive and determine the peak resonant M_p and bandwidth ω_{BW}.

3. (20%) Please show that all eigenvalues of $\mathbf{A}$ have negative real parts if and only if for any given positive definite symmetric matrix $\mathbf{N}$, the Lyapunov equation $\mathbf{A}^T \mathbf{M} + \mathbf{M}\mathbf{A} = -\mathbf{N}$ has a unique positive symmetric solution $\mathbf{M}$ and $\mathbf{M}$ is positive. (Hint: $\mathbf{M} = \int_0^\infty e^{\mathbf{A}^T t} \mathbf{N} e^{\mathbf{A}t} dt$)
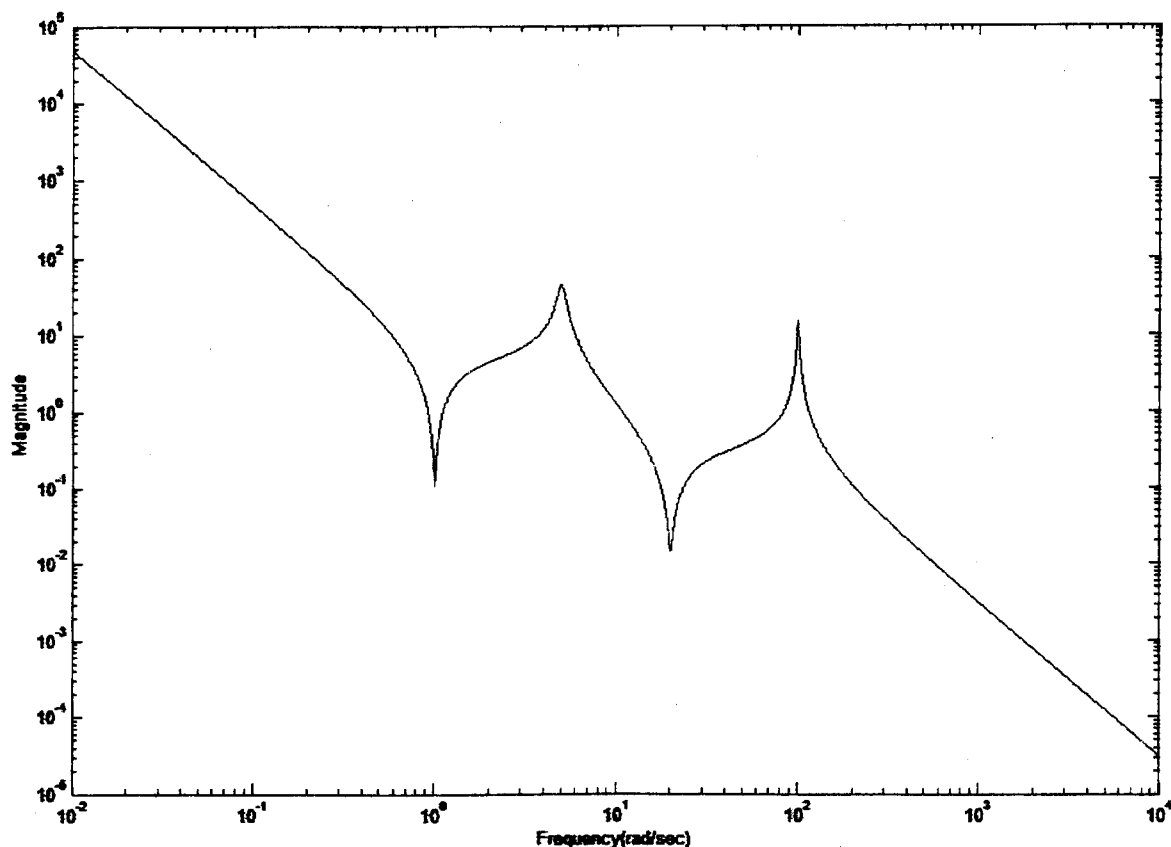

Figure 1

（背面仍有題目,請繼續作答）

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4. (10%) Determine $\Phi(s)$ and $\Phi(t)$ for the system with $\dot{\mathbf{x}} = \begin{bmatrix} -1 & 0 \\ 4 & -3 \end{bmatrix}\mathbf{x} + \begin{bmatrix} 3 \\ 5 \end{bmatrix}\mathbf{u}$.

5. (20%) Design an op-amp controller to realize the following phase-lead transfer function: $G_c(s) = (s + 1)/(s + 4)$.

6. (20%) A unity negative feedback control system has the plant transfer function

$$G(s) = \frac{K(s + 1)}{s^3 + \alpha s^2 + 2s + 1}$$

Find the values of K and α so that this system oscillates at a frequency 2 rad/sec.