科目：控制系統(300D)

校系所組：中央大學電機工程學系（系統與生醫組）
交通大學電控工程研究所（甲組、乙組）
清華大學電機工程學系（甲組、丁組）

參考用

一. Consider the dynamic equation (25%)

$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}\mathbf{x} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u \ , \ y = \begin{bmatrix} 2 & 1 \end{bmatrix}\mathbf{x}$$

Find an initial state so that its zero input response is $y(t) = 8e^{-t}$, $t \geq 0$.

二. Consider a delayed system as given below, where (15%)

$$G(s) = \frac{\sqrt{2}}{s(s+1)} \quad \text{and} \quad C(s) = e^{-Ts}$$

Please find the maximum time delay T with the closed-loop stability.

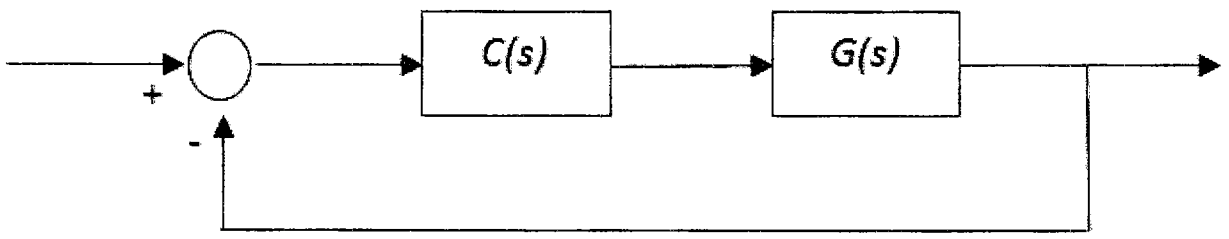

Figure 1

三. $\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}\mathbf{x} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u \ , \ y = \begin{bmatrix} 1 & 0 \end{bmatrix}\mathbf{x} + u$

What is the steady-state response $y_{ss}(t)$ if the input is $u(t) = 5\sin t$? (10%)

四. The loop transfer function of a single-loop feedback control system is given by

$$G(s)H(s) = \frac{K(s+5)}{s(s+2)(1+Ts)} \ .$$

Determine the conditions with inequalities of T and K so that the closed loop system is asymptotically stable. (14%)

注意：背面有試題

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五. The loop transfer function of a control system is $L(s)=\frac{A}{s(s+B)(s+C)}$, where A, B, C are positive constants.

Assume the Nyquest plot of $L(jw)$ is shown in Figure 2.

(a) Roughly draw a diagram similar to Figure 2 and indicate the locations of "gain crossover point", "phase crossover point", "gain margin" and "phase margin" in your diagram. (2% for each). Furthermore, give the definition of each item above and explain why those items are at those locations respectively. (8%)

(b) Is the system stable or not? Give the reason only from the observation of Figure 2. (Answer it in English or in Chinese) (10%)

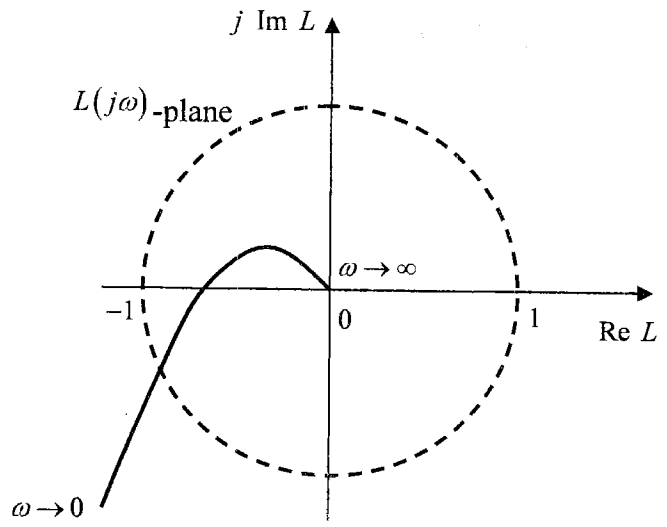

Figure 2

六. Please draw a digram similar to Figure 3 which is a typical unit-step response of a control system in time domain. Then indicate "Delay time", "Rise time", "Maximum overshoot", "Settling time" and "Steady-state error" in your diagram and define them respectively. (10%)

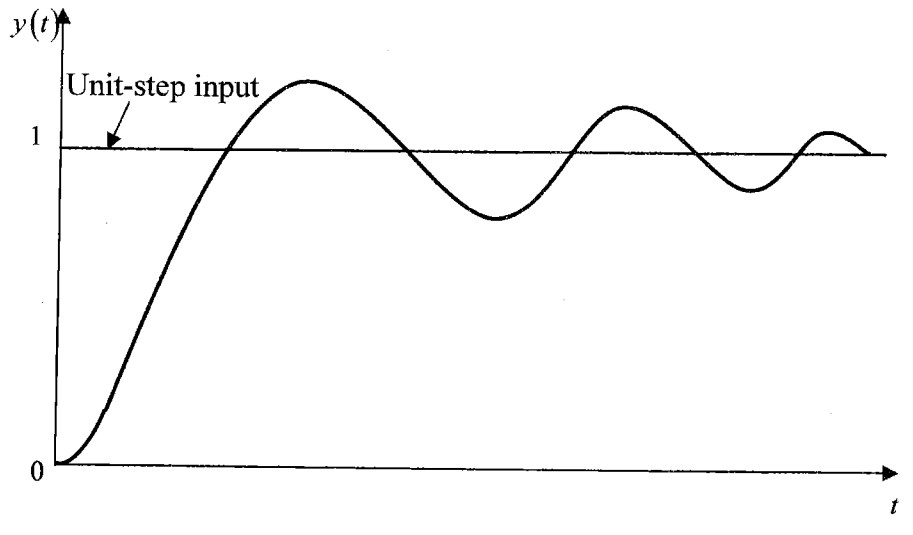

Figure 3