※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

1. (25%) For the circuit shown in Fig. 1, find the values of R_2 and C to yield 10% overshoot with a settling of 2ms for the voltage across the capacitor, with $v_i(t)$ as a step input.

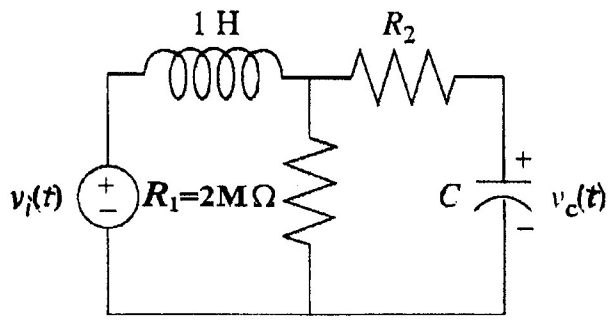

Fig. 1

2. (25%) For the system shown in Fig. 2, find the value of gain K that will make the system oscillate. Also, find the frequency of oscillation.

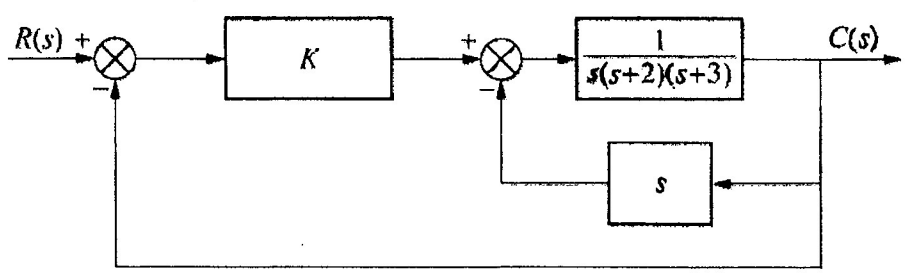

Fig. 2

3. (16%, 4% each) For the system shown in Fig. 3, determine the steady state error for the following combinations of input and parameter

(a) $R(s)=1/s$ and $a=2$,
(b) $R(s)=1/s$ and $a=4$,
(c) $R(s)=1/s^2$ and $a=0$,
(d) $R(s)=1/s^2$ and $a=4$.

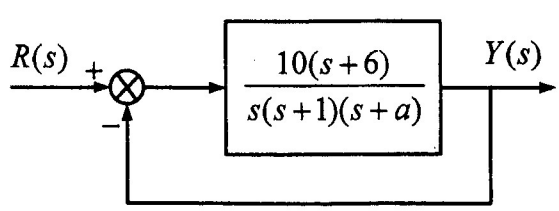

Fig. 3

(There are more problems on the next page)

(背面仍有題目,請繼續作答)

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4. (20%, 5% each) Consider a unity negative feedback system in which the Nichols chart of the open loop transfer function is given in Fig. 4. Answer the following questions

(a) What is the phase margin of the system?

(b) What is the bandwidth of the system?

(c) What is the peak magnitude of the closed-loop response?

(d) Suppose that the loop transfer function is multiplied by a pure gain K, determine the range of K so that the closed-loop system is stable.

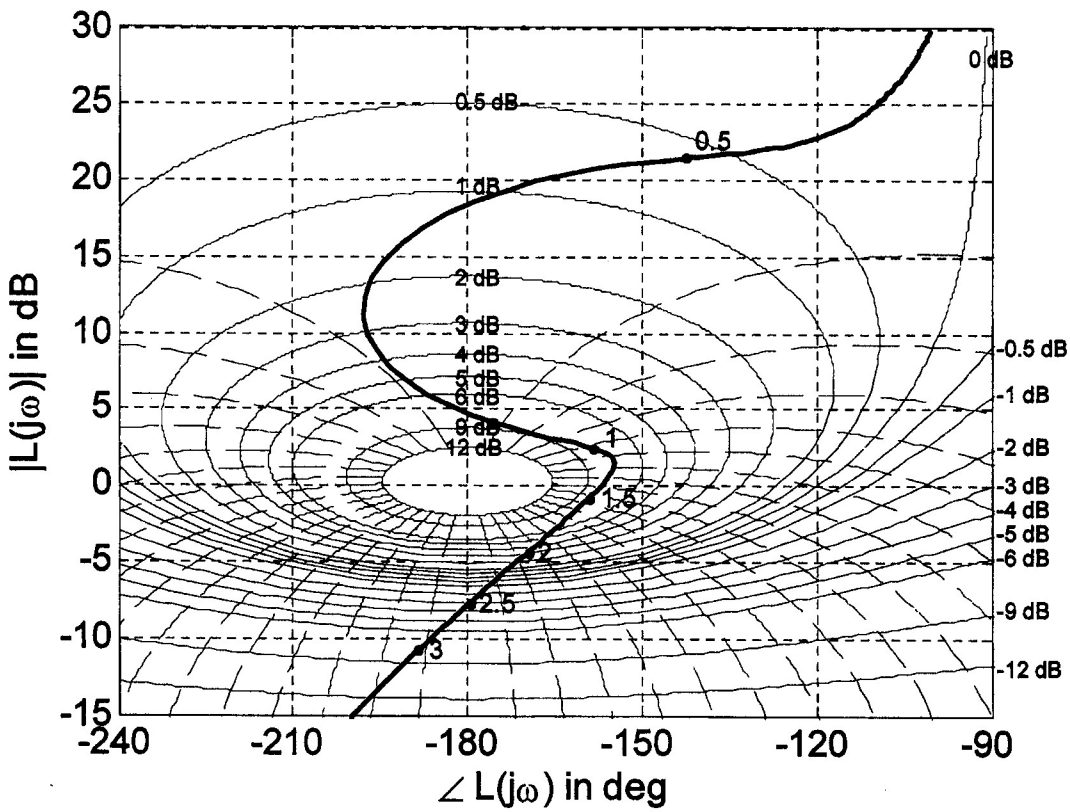

Fig. 4

5. (14%) Consider the linear system $\dot{x} = Ax + Bu$, $y = Cx$, where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & -1 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \quad C = \begin{bmatrix} 1 & 2 & 0 \end{bmatrix}$$

Determine an appropriate linear state feedback control law $u = Fx + Gr$ so that the closed-loop transfer function from r to y is equal to $H(s) = \dfrac{2}{s^2 + 2s + 2}$.