淡江大學 101 學年度碩士班招生考試試題

系別：電機工程學系控制系統組
電機工程學系機器人工程所

科目：控 制 系 統

考試日期：2 月 26 日(星期日) 第 2 節

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1. Consider a system as follow

$$\frac{d^2x}{dt^2}+3\frac{dx}{dt}+2x=u$$

where x is the system output and u is the control input.

(a) Write the state equation for it? (5%)

(b) Is it a stable system? Please explain it. (5%)

(c) Is this system controllable? Is this system observable? Please explain it. (5%)

2. Consider a system as follow

$$\frac{d^3y}{dt^3}+3\frac{d^2y}{dt^2}-\frac{dy}{dt}+6y=\frac{d^2x}{dt^2}-x$$

$$y(0^+)=0,\quad \left.\frac{dy}{dt}\right|_{t=0^+}=0,\quad \left.\frac{d^2y}{dt^2}\right|_{t=0^+}=1$$

$$x(t)=5\sin t$$

(a) Find the output transform $Y(s)$. (10%)

(b) Determine the transfer function between $Y(s)$ and $X(s)$. (5%)

3. Find the steady state error to a ramp input of the system as shown in Fig. 1. (10%)

4. Consider a system as shown in Fig. 2.

(a) Suppose that $a=3$, $b=2$ and $c=6$. Find the range of k for which the closed-loop system is stable. (10%)

(b) Suppose that the system parameters have parameter uncertainties as $a\in[2,4]$, $b\in[1,3]$ and $c\in[5,7]$. Find the range of k for which the closed-loop system is stable. (10%)

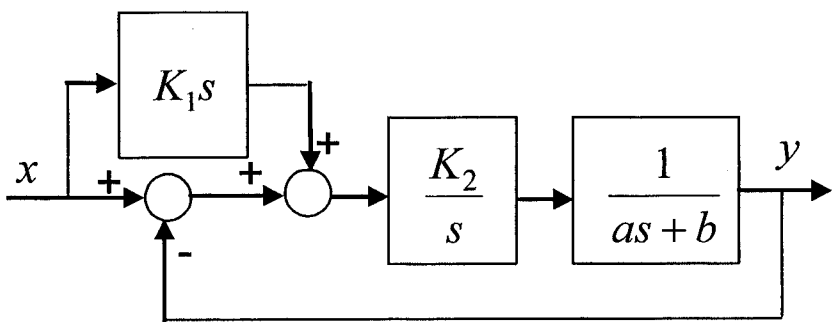

Fig. 1

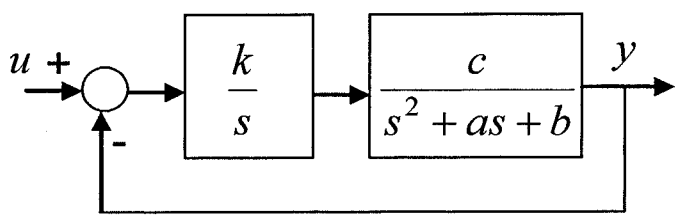

Fig. 2

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5. Consider a system as shown in Fig. 3. Please design a PID controller, C, to satisfy all the following conditions. (10%)
   (a) Zero steady state error for a constant input.
   (b) A steady state error of 0.05 for a unit ramp input.
   (c) A system damping ratio of 0.5.
   (d) A settling time of 2sec.

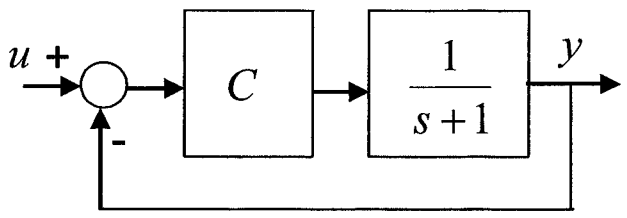

Fig. 3

6. Consider a unity-feedback control system whose open-loop transfer function is $\frac{as+1}{s^2}$.
   Determine the value of a so that the phase margin is equal to 45^o. (10%)

7. Consider an electrical circuit as shown in Fig. 4, where $[v_1, v_2, i_2]$ is the state vector of the system, V_{out} is the output value of the system and $[V_{in}, I_{in}]$ is the control input vector of the system.
   (a) Determine the state equation of the system. (10%)
   (b) Is it stable? Please explain it. (10%)

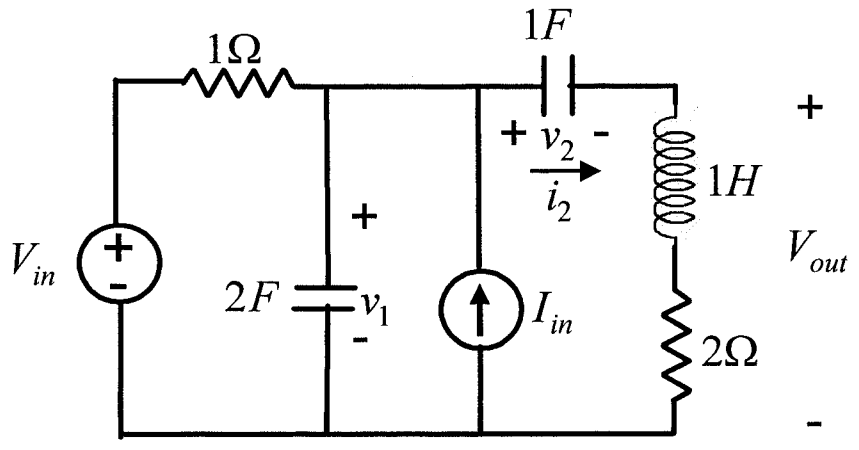

Fig. 4