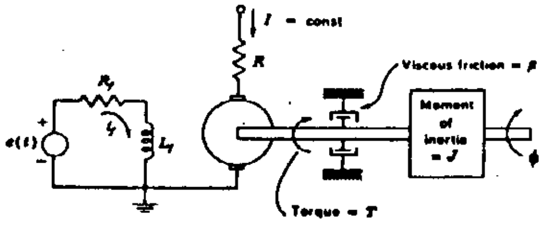
國立臺灣科技大學
八十七學年度碩士班招生考試試題

所　別：工程技術研究所
學程別：自動化及控制學程
組別：控制組
科目：控制系統

1. A field-controlled DC motor driving frictional and inertial load is shown in Figure 1. The input is e(t) and the output is the shaft position $\phi(t)$. The torque $T(t) = K^*i_f$ (10%)
   (1) Find the system transfer function $G(s)=\phi(s)/e(s)$.
   (2) State how the system can be modified to become a closed-loop speed control system.



Schematic diagram of a dc field-controlled motor.

Figure 1

2. If a system is described by $x(k+1)= AX(k)+ Bu(k)$, the state transition matrix is defined by $G(n)=A^n$. and $A = \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix}$
Use the Cayley-Hamilton theorem to obtain G(2), G3), G(4) in terms of A and I. (10%)

3.For each of the following Laplace-transformed signals, find the initial value and the final value if it exists. (10%)
(1) $Y(s)= \dfrac{6s^2+5}{s^3+2s^2+11s}$
(2) $Y(s)= \dfrac{30}{s^3+2s^2+11s+3}$

4.Use the Routh criterion to investigate the stability of the following characteristic equations.(10%)
(1) $s^4+3s^3+2s^2+10s+2=0$
(2) $s^3+2s^2+s+2=0$

命題請勿超出框外

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5. Reduce the block diagrams shown in figure 2 to obtain the system transfer functions. (10%)

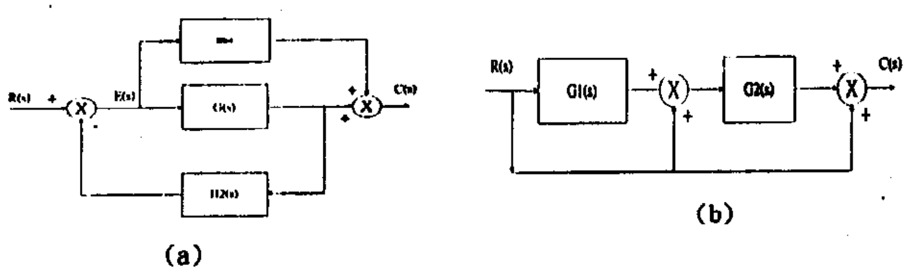

Figure 2

6. A closed-loop system of a servomechanism is shown in figure 3.

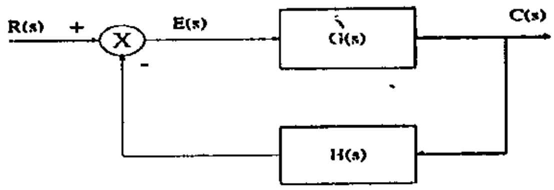

Figure 3.

where $G(s)= k_1/S^2$ and $H(s)= 1+ k_2S$.
if the maximum overshoot in unit-step response is 50% and the peak time is 5 sec. (20%)
(1) Calculate the damping ratio ξ and undamped nature frequency ω_n (10%)
(2) Determine the parameters k_1 and k_2. (10%)

7. Consider that an open-loop transfer function of a control system with unity feedback is given by

$$G(s)= \frac{k}{s(1+s)(5+s)}$$

For k = 12, the magnitude of G(jw) at the phase-crossover frequency 2.236 rad/s is -8 dB, and the phase of G(jw) at gain-crossover frequency 1.37 rad/s is -159 degrees. (30%)
Note: log2=0.301　log3=0.477

(1) Plot the bode diagram of G(s) for w = 0.2 to 10. (8%)
(2) Sketch the Nyquist plot for w=0.1, 0.2,0.5, 1, 2, 5,10.(6%)
(3) Find the gain margin ,phase margin, check the system stability.(6%)
(4) Estimate the gain margin, phase margin and check the system stability for k=120. (5%)
(5) Find the range of k for system stability from the gain margin obtained in (3). (5%)