

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：機械工程技術研究所
學程別：

組別：控制組

科目：線性系統控制

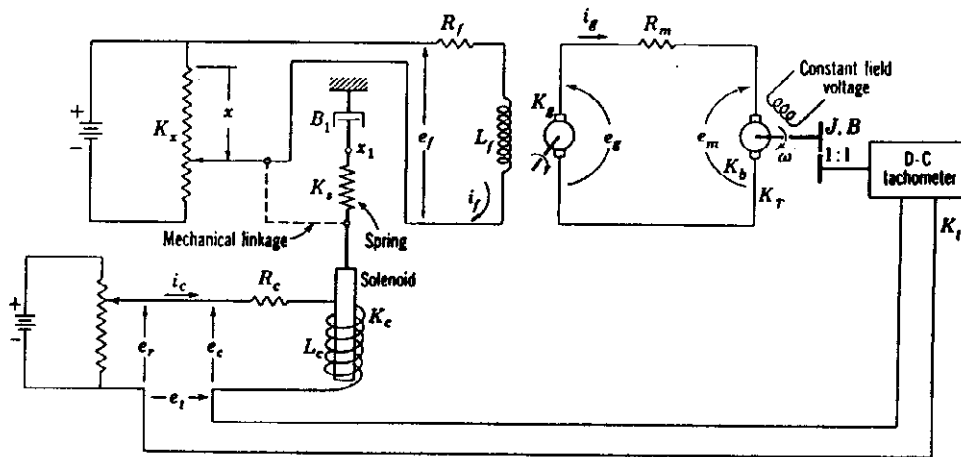


Fig. 1

1. A DC-motor control system shown as Fig.1. The force of attraction on the solenoid is given by $f_c = K_c i_c$. The voltage appearing across the generator field is given by $e_f = K_x x$. The voltage generated by the generator is $e_g = K_g i_f$. Motor torque T is proportional to the armature current i_a by a constant K_T . The back emf e_m is proportional to the rotation speed ω . The voltage e_t of DC-tachometer is proportional to the rotation speed by a constant K_t . Draw the block diagram, which should indicate variables $e, i_c, x, i_f, e_g, T, \omega$, and e_t is the system input and ω is the output. [15%]

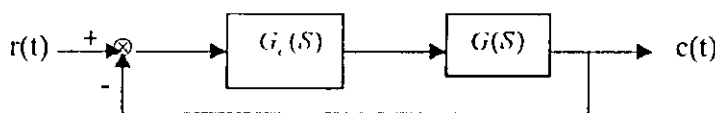


Fig. 2

2. As Fig.2, $G_c(S) = K$ and $G(S) = \frac{e^{-TS}}{S(S+1)^2}$, design K and T to satisfy gain margin=2 and phase cross-over frequency=0.1Hz. [15%]

3. As Fig.2 and $G(S) = \frac{1}{S(S+2)}$,

(i) design $G_c(S)$ so that system damping ratio=0.5, settling time=2sec. and velocity error constant=4. [15%]

(ii) then, draw Bode diagram of $\frac{C}{R}(j\omega)$ and find the steady state output when $r(t) = 2\cos(2t)$. [15%]

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$$4. \dot{X} = AX + BU, Y = CX, X = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}, A = \begin{bmatrix} -1 & -1 & 0 \\ 1 & -3 & 0 \\ 0 & 0 & -4 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}, C = [1 \ 0 \ 0],$$

- (i) find the transition matrix e^{At} . [15%]
(ii) determine and explain which state variable is uncontrollable or unobservable. [10%]

5. A continuous-time system is simulated as $\dot{x} = -x + u$. Determine the optimal control law ($u = -Kx$) to minimize the performance index $J = \int_0^{\infty} (x^2 + u^2) dt$. [15%]