

科目：控制工程

系所組：電機工程(乙組)

1. A linear time-invariant system is described by the following differential equation. Derive its dynamic equation in vector matrix form. (15%)

$$\frac{d^2v(t)}{dt^2} + 3\frac{dv(t)}{dt} + 2v(t) + \int_0^t v(\tau)d\tau = u(t)$$

2. A controlled process is represented by the given state equations: $\dot{x}_1 = x_1 - 2x_2$; $\dot{x}_2 = 3x_1 + u$. The control is obtained from state feedback such that $u = -\alpha x_1 - \beta x_2$ where α and β are real constants.

- (a) Plot the locus in the α versus β plane on which the overall system has a natural undamped frequency $\omega_n = 2$ rad/sec. (9%)
 (b) Find the values of α and β such that damping ratio $\zeta = 0.5$ and $\omega_n = 2$ rad/sec. (6%)

3. The characteristic equation of a feedback control system is given by $s^3 + 3Ks^2 + (K+1)s + 6 = 0$. Determine the values of K for a stable closed loop system. (15%)

4. The characteristic equation of a feedback control system is given by $s(1+0.025s)(1+0.02s) + K = 0$
 (a) Sketch the root locus diagram of the system (positive K only). (15%)
 (b) Determine the marginal value of K that will cause instability. (5%)

5. The pole-zero configuration of a closed-loop transfer function is shown in Fig. 5-1.
 (a) Find the bandwidth of the system. (5%)
 (b) A zero is added to the closed-loop system, as shown in Fig. 5-2; how is the bandwidth affected? (5%)
 (c) Another pole is inserted on the negative real axis in Fig. 5-2, but at a distance 10 times farther from the origin than the zero; what is the closed-loop transfer function? (5%)

6. The RC network shown in Fig. 6 is used for the phase-lag compensation of a control system to result in the maximum phase lag ϕ_m occurring at the frequency $\omega_m = 0.5$ rad/sec.

- (a) Determine the value of the resistance R of the network. (10%)
 (b) Find the transfer function $E_o(s)/E_i(s)$. (5%)
 (c) What is the maximum phase lag ϕ_m at $\omega_m = 0.5$ rad/sec? (5%)

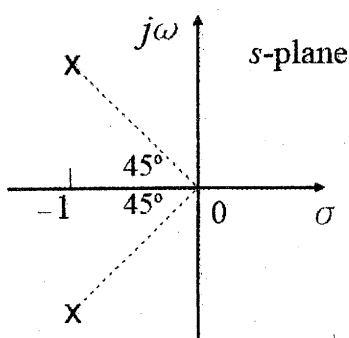


Fig. 5-1

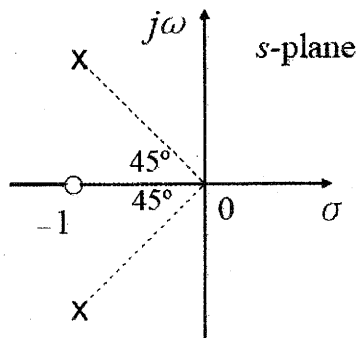


Fig. 5-2

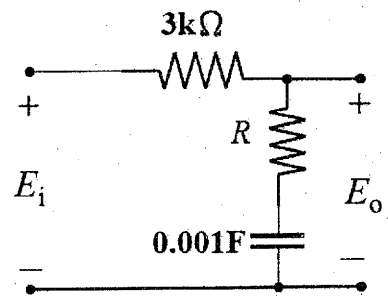


Fig. 6

※ 注意：1.考生須在「彌封答案卷」上作答。

2.本試題紙空白部份可當稿紙使用。

3.考生於作答時可否使用計算機、法典、字典或其他資料或工具，以簡章之規定為準。