25% 1) The transfer function of a control network is determined to be

$$G(s) = \frac{s}{(1+0.5s)(1+0.12s+0.04s^2)}$$

a. Find the breaking frequency. b. Caculate the damping ratio ς.
c. Draw the Bode plot of the network by a relation of magnitude(db) to frequency(ω).

25% 2) An airplane is having a dynamics as follows:

$$\dot{u} = -0.08\,u - 32.2\,\theta \qquad \dot{\alpha} = q - 0.0004\,u - \alpha \qquad \dot{q} = -3.6\,\alpha - 3.6\,\delta \qquad \dot{\theta} = q$$

a. Find the transfer function for Θ/Δ where Θ and Δ are the Laplace transform of θ and δ respectivelly.
b. Take $K = -2$ for the closed-loop system shown in Fig. 1. Write the transfer function for Θ/Θ_i. Use te Routh-Hurwitz discriminant to determine the stabiluity of the system.

25% 3) Correlate the Nyquist plots, step responses and frequency responses shown in Fig. 2.

25% 4) Two Nyquist diagrams for unity feedback systems that are open-loop stable are sketched in Fig. 3 and Fig. 4. The proposed operating gain is indicated as K_0, and arrow indicate increasing frequency. In each case give your best estimate for a) Phase margin b) Range of gain for stability (if any) and c) Syatem types as 0, I or II.

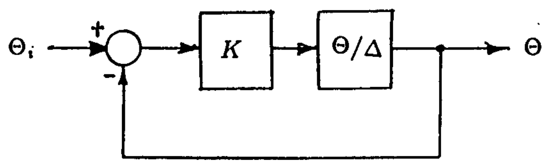

Fig. 1

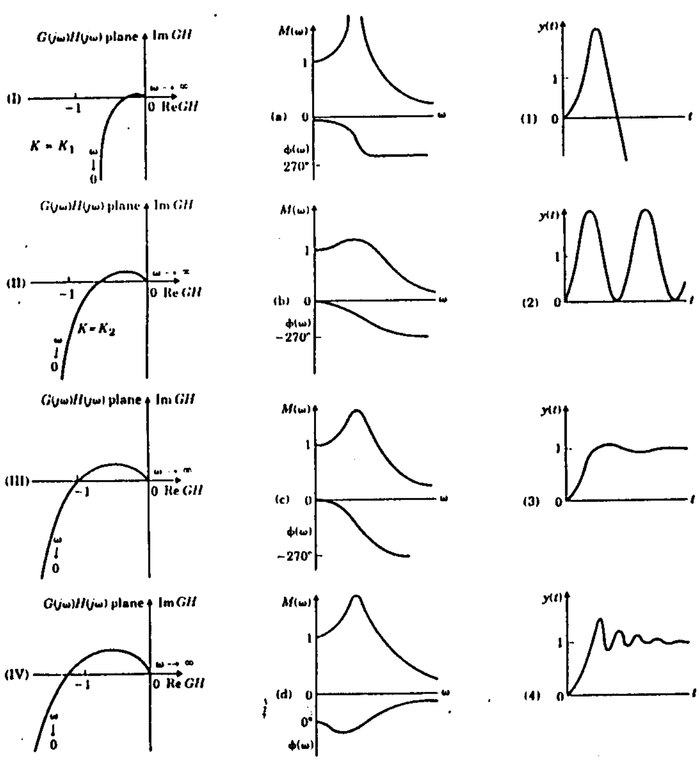

Fig. 2

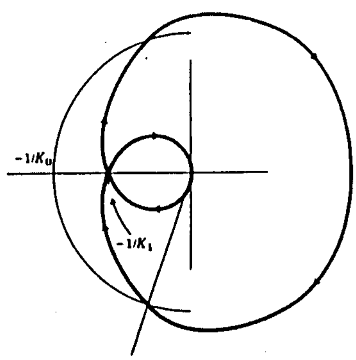

Fig. 3

	G
30	$1/K_1$
10	$1/K_0$
0	×

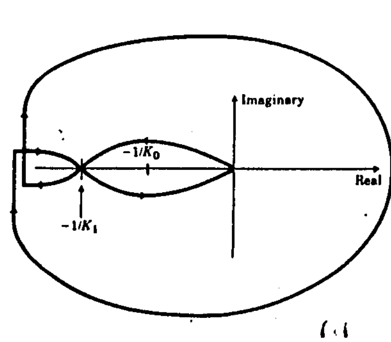

Fig. 4

ω	|G|
0	∞
0.1	$1/K_1$
1.0	$1/K_0$