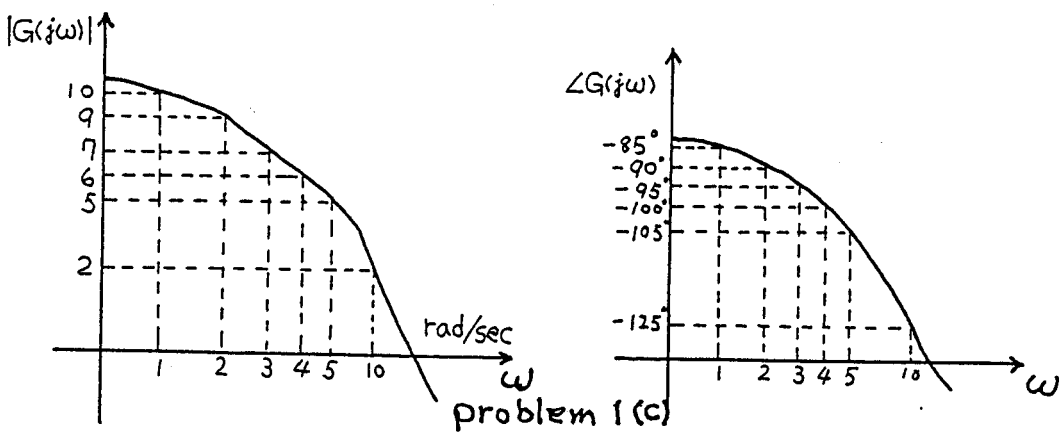
線性系統

1. Definition of linear system

10% (a) Consider a system G, if the input and output of G can be measured, explain how you can determine that G is linear.

10% (b) Given a linear system G, please propose three methods to describe the behavior of G.

10% (c) The Bode plot of G(s) is given as follows:



problem 1 (c)

If the input signal is 5 sin3t + 2 cos10t, please find the output signal.

2. Stability of linear system.

10% (a) Consider the system:

$$\dot{X} = AX,\ X(0) = X_o,\ X \in R^n$$

Find the solution X(t) in terms of the eigenvalues and eigenvectors of A.

10% (b) Prove that the system is unstable, if one of the eigenvalues of A is within the right half plane.

3. For the unity feedback system, as shown in Fig. 3–1, with

$$G(s) = \frac{(-0.2s + 1)}{s(s + 1)[(s^2/25) + 0.4(s/5) + 1]}$$

(a). Draw the Bode plots for G(jw).(7%)

(b). Draw the Nyquist plot for G(jw).(7%)

(c). Draw the Nichols plot (gain–phase) plot for G(jw).(7%)

(d). Determine the gain margin when the gain K is set for a phase margin of 45°.(5%)

(e). What is velocity error coefficient K_v when the gain is set for a 45° phase margin?(5%)

(f). Sketch the root locus versus system gain K and indicate the roots for a phase margin of 45°.(7%)

(g). Determine the range of K such that the closed–loop system is stable.(7%)

(h). How to determine closed–loop stability using the Nyquist stability criterion?(5%)

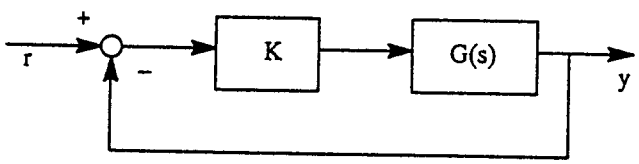


Fig. 3–1.