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

工程技術研究所 自動化及控制學程

碩士班入學考試 Control System 試題 April 1997

1. Give the comparison of an open-loop control system and closed-loop control system on construction, cost, stability ,sensitivity, and effect of external disturbance. (10%)

2. Consider a closed-loop system shown in figure 1.

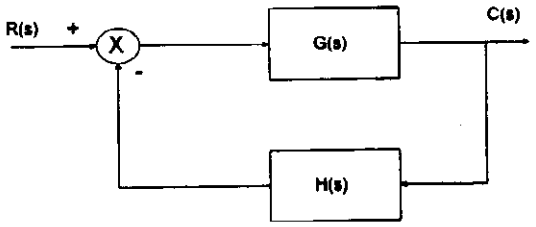

Figure 1.

where $G(s)=\frac{10(s+1)}{s(s-3)}$ and $H(s)=1$

(1) What are the closed-loop poles and zero? (3%)
(2) Sketch the root locus.(7%)
(3) Find the unit-step response c(t). (7%)
(4) Calculate c(t) at t= 0, 1, ∞ (3%)

3.Sketch the root locus of a closed-loop system with unity feedback gain as shown in figure 1.

where $G(s)=\frac{64k}{s(s+4)(s+16)}$, $H(s)=1$ and $E(s)=R(s)-C(s)$

(1) Sketch the root locus.(7%)
(2) Determine the range of k for which the system is stable. (5%)
(3) Determine the range of k such that the steady state error e(t) is less than 0.1 with a ramp input r(t) = t, t>0. (5%)
(4) Find the steady state error e(t) for an unit-step input r(t)=1, t>0. (3%)

4. For a transfer function $G(s)=\frac{C(s)}{U(s)}=\frac{s+4}{s^3+6s^2+11s+6}$

Transfer to a state model $\dot{X}=AX+BU$ and draw the signal-flow graph using nodes u, x_3, x_2, x_1, c, etc.(15%)

5. Outline the methods for the determination of the stability of linear continuous-data system, without involving root solving. (15%)

6. Consider that an open-loop transfer function of a control system with unity feedback is given by $G(s)=\frac{k}{s(1+0.02s)(1+0.2s)}$ and the bode plot of G(s) is shown in figure 2. From the graph, the magnitude of G(jw) at the phase-crossover frequency 15.88 rad/s is -14.82 dB, and the phase of G(jw) at gain-crossover frequency 6.22 rad/s is -142.28 degrees.

(1) Find the gain margin ,phase margin, the value of k and check the system stability.(6%)
(2) Sketch the Nyquist plot.(6%)
(3) Estimate the gain margin ,phase margin and check the system stability for k=1(4%)
(4) Estimate the gain margin ,phase margin and check the system stability for k=100(4%)

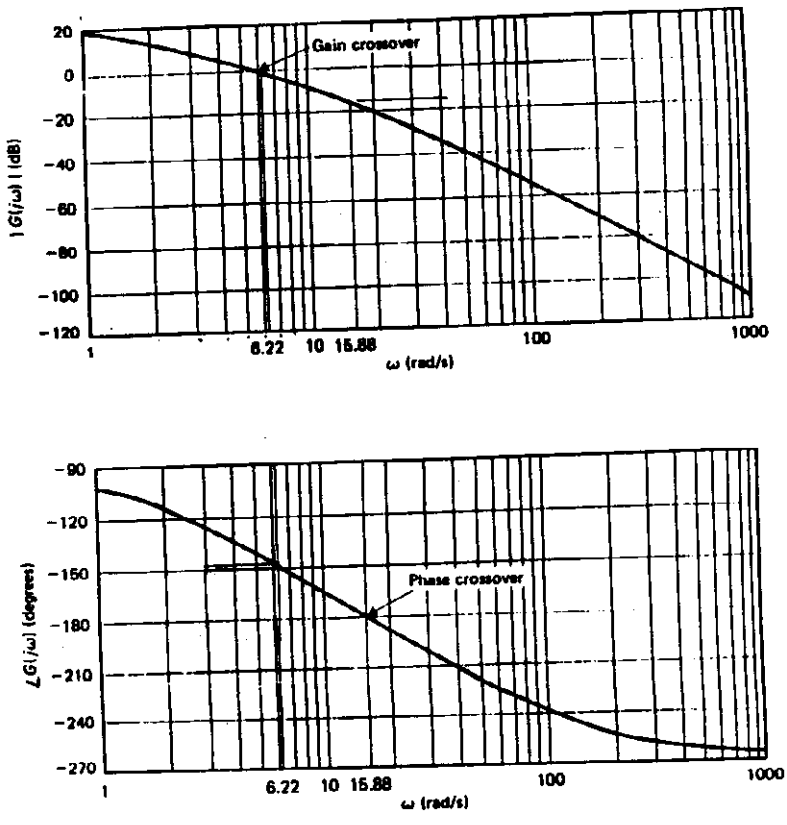

Figure 2. Bode plot of G(s)= k/[s(1+0.02s)(1+0.2s)]