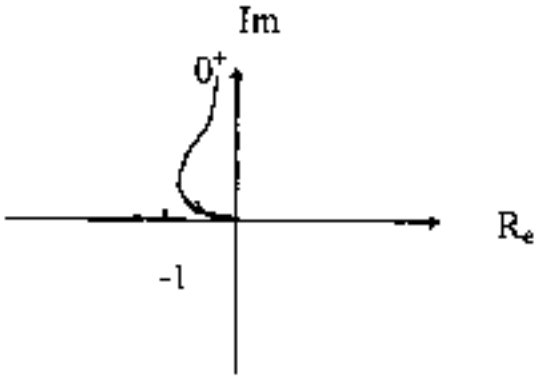
八十六學年度 工程與系統科學系（所） 組碩士班研究生入學考試

科目 控制系統 科號 407 共 2 頁第 1 頁 *請在試卷【答案卷】內作答

1. Consider the polar plot of a open-loop transfer function as shown below (30%)



(a) Write the possible transfer functions and the location of pole and zero

(b) Plot Nyquist diagram and discuss the stability of the unit feedback closed-loop system.

2. PI control $G_c = k_P + k_I / s$ is applied to the plant $G(s) = 2/[(s+1)(s+2)]$. The loop gain function is $G_c G = 2k_P \dfrac{s+z}{s(s+1)(s+2)}$ $\left[z = \dfrac{k_I}{k_P}\right]$

The shape of the loci is determined by the choice of z, and the position of the closed-loop poles along the loci by the root locus gain $2k_P$.

Consider system step responses for three different choice of z:

a) $z<-2$,

b) $-1<z<-2$,

c) $-1<z<0$.

For the design, two closed-loop poles are located at the 60° line. Discuss, qualitatively, the performance such as rise time and percent overshoot of three controllers. (Your discussion should be as detailed as possible). (30%)

3. Consider the state variable feedback system (40%)

$$\dot{x} = Ax + Bu$$

$$u = Hx$$

$$\Rightarrow \dot{x} = (A - BH)x \cdot Dx$$

and the performance index

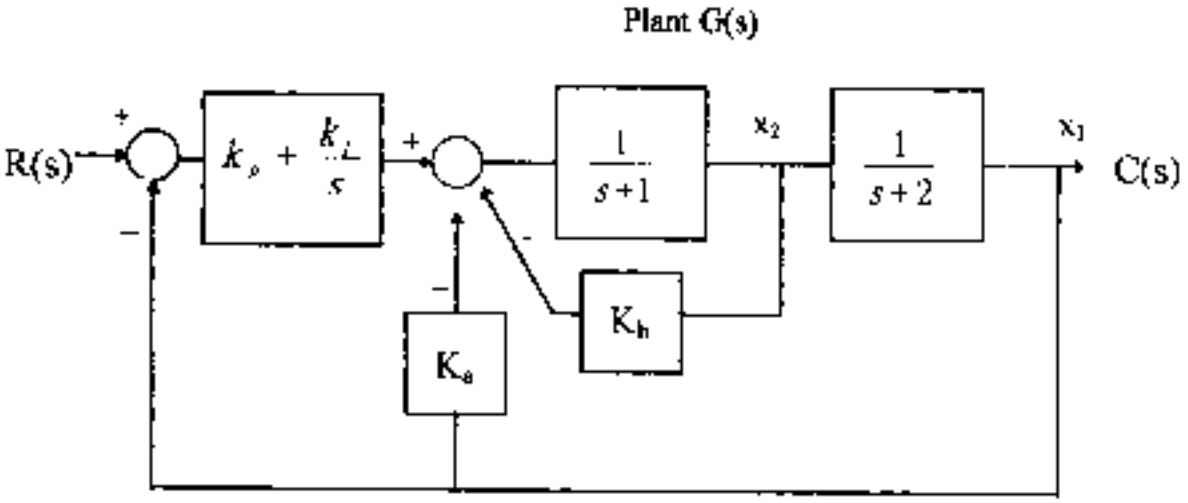
$$J = \int_0^\infty x^T Q x dt$$

Then $J = x^T(o) P x(o)$

where P is symetry and satisfies

$$D^T P + PD = -Q$$

Now consider the system shown below



assume that $x_1(0)=1$, and define $J = \int_0^\infty x_1 x_1 dt$

Find the gain k_p, k_I, k_a, and k_h that minimize J.