# 國立成功大學
# 115學年度碩士班招生考試試題

編　號：95

系　所：航空太空工程學系

科　目：自動控制

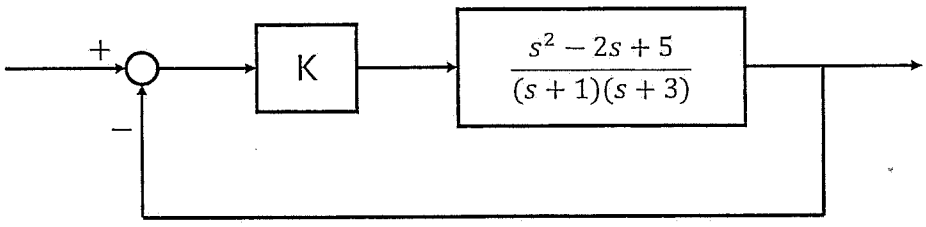
日　期：0203

節　次：第 1 節

注　意：1.不可使用計算機
2.請於答案卷(卡)作答，於試題上作答，不予計分。

## Problem 1 (20%)

Given the following block diagram:



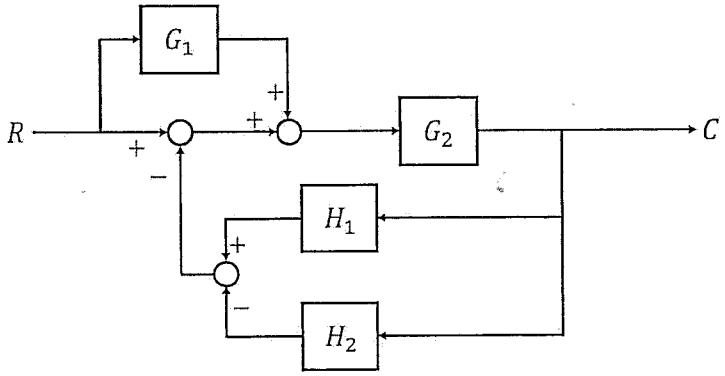

Suppose K is greater than zero. Please answer the following questions:

I. What is the range of K such that the closed-loop system is stable? (10%)

II. When the damping ratio $\zeta = 0.5$, what is the corresponding value of K. (10%)

## Problem 2 (30%)

Given the following block diagram:




where $G_1 = \frac{1}{s+3}, G_2 = \frac{1}{s(s+5)}, H_1 = \frac{3}{s+1}$ and $H_2 = 2$. Please answer the following questions:

I. What is the expression of the closed-loop transfer function $(\frac{C(s)}{R(s)})$? (15%)

II. Determine the system type (type number). (5%)

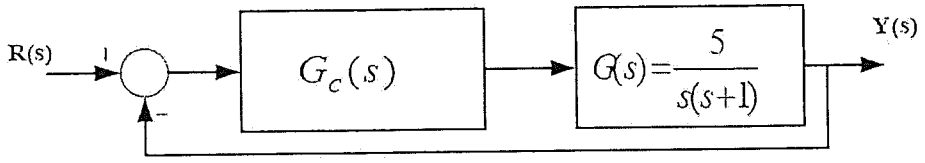
III. Suppose a unit-step input is given to this system. What is the corresponding steady-state error? (10%)

3.

(a). Consider the system shown in Fig.3 and determine the gain margin and phase margin of the system for Gc(s) = K = 1. (5%)

(b). Design a dynamic control such that the resulting system has a phase margin of 45° and the steady state error to a unit ramp reference R(s) is equal to 0.1. (10%)

(c). For Gc(s) obtained in (b), draw the Bode plot of G(s)Gc(s). (10%)



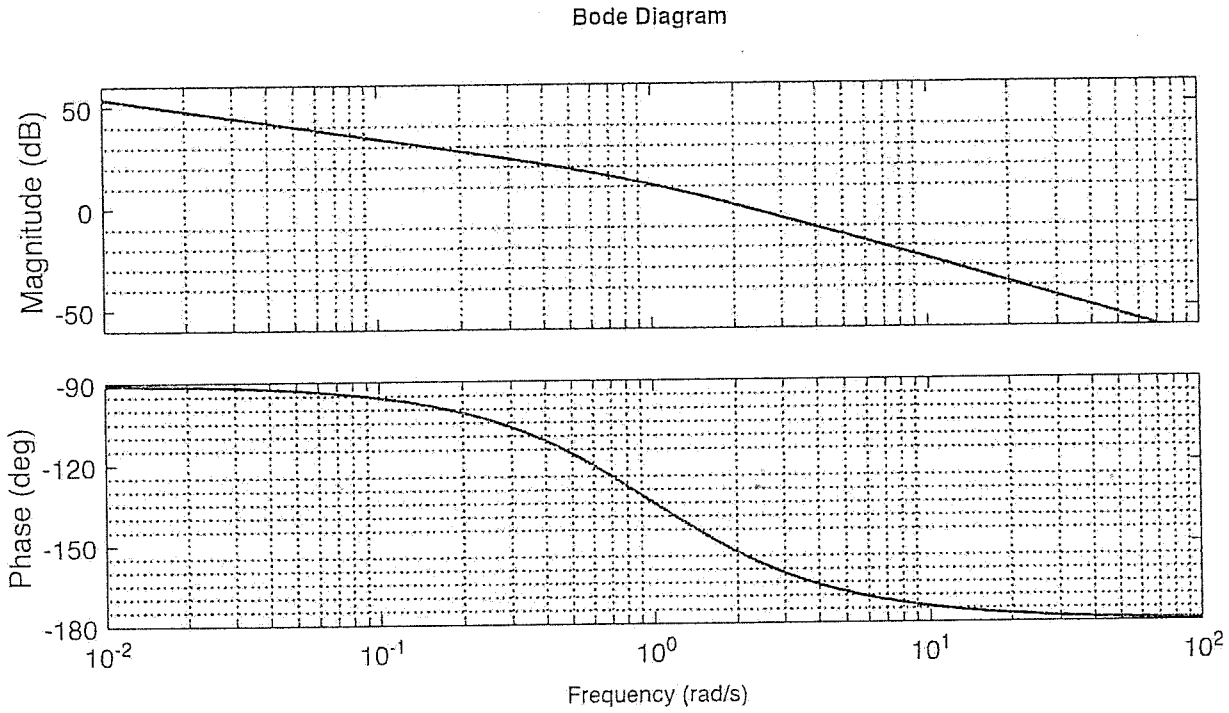




Fig.3. System diagram and Bode plot.

4.

Consider the following root locus plot of $G(s)=\dfrac{k(s+a)}{s(s+b)(s+c)}$ with $k>0$.

(a) Determine the range of $k$ so that the closed-loop system is stable. (5%)

(b) Determine the required value of $k$ to place the closed-loop pole at -2.5+8$i$. (5%)

(c) Determine the value of k for the breakaway point on the locus. (5%)

(d) With the $k$ obtained in (b), determine the corresponding steady state error of the unity negative feedback system to track a unit ramp and a unit step inputs. (10%)

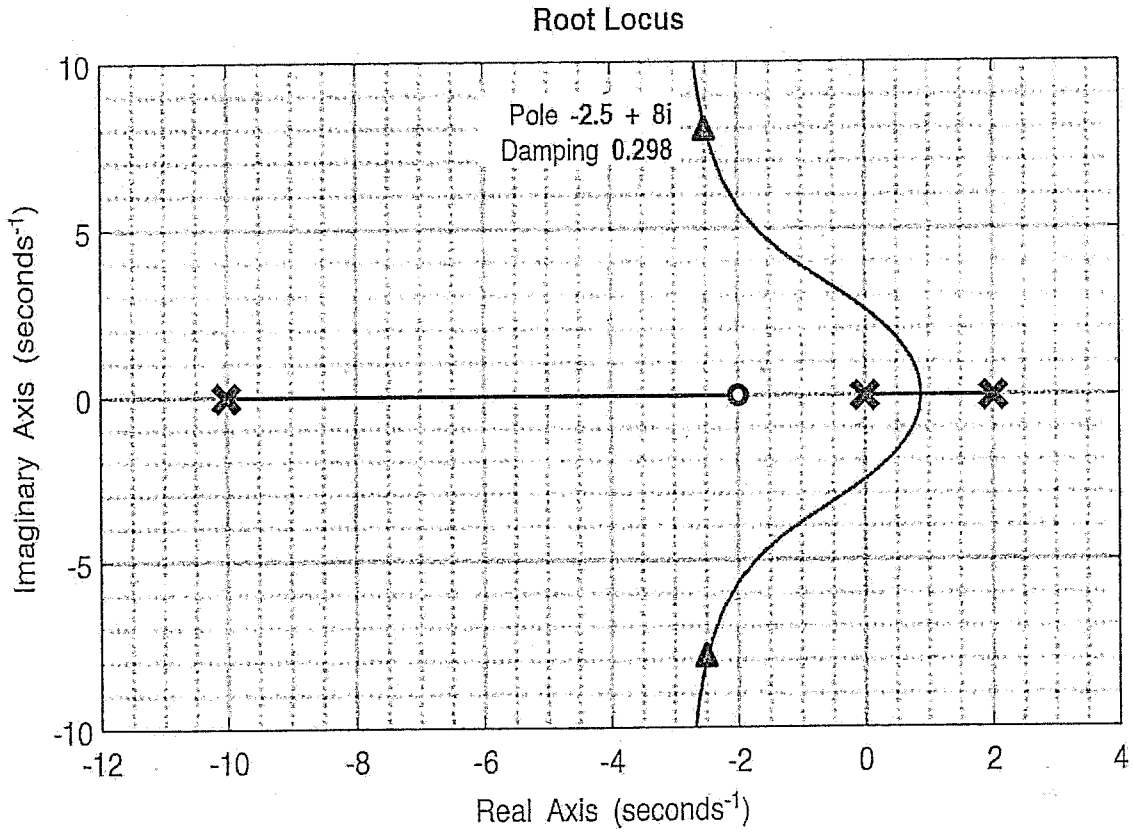



Fig. 4. Root locus plot.