國立成功大學

111學年度碩士班招生考試試題

編　號：133

系　所：航空太空工程學系

科　目：自動控制

日　期：0219

節　次：第 1 節

備　註：不可使用計算機

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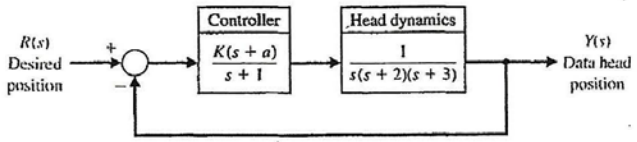
※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (25%) Large welding robots are used in today's auto plants. The welding head is moved to different positions on the auto body, and a rapid, accurate response is required. A block diagram of a welding head positioning system is shown as follows.



(a) Please derive the characteristic equation of the system. (5%)

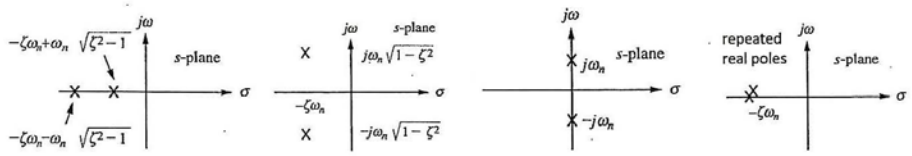
(b) What is the steady state error when the desired position is a step input? (5%)

(c) Please determine the range of K and a for which the system is stable. (5%)

(d) Suppose that $K=40$, please find the range of a that makes the system stable. (5%)

(e) Please draw the root locus when $a=-1$. (5%)

2. (25%) For an open-loop second order system, consider the following four cases:



(f1)　(f2)　(f3)　(f4)

(a). Determine the range of the damping ratio of figures (f1)~(f4). (5%)

(b). Please draw the time response when the input is a step function. (5%)

(c). What is the steady state for each case when applying a step input? (5%)

(d). Please derive the time domain analytic solution of (f2), in which a step input is applied. (10%)

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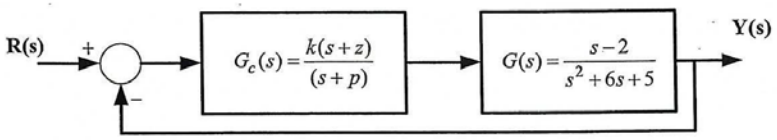
3.(30%)

Consider a non-minimum phase system described as follows

(a). Design a first order controller $G_C(s)$ using the root locus method, such that the error to a step input is zero and the complex closed-loop pores are located at $-1 \pm j$. (15%)

(b). Draw the root locus of the compensated system with $G(s)G_C(s)$ obtained in (a). (10%)

(c). Determine the corresponding *gain margin* of the compensated system. (5%)



4. (20%)

Draw the Nyquist plot of the system $G(s)=\frac{5(s+2)}{s(s-1)}$. (10%)

Determine the closed-loop stability by Nyquist stability criterion. (10%)