國立成功大學
111學年度碩士班招生考試試題

編　號：70

系　所：機械工程學系

科　目：自動控制

日　期：0219

節　次：第 1 節

備　註：可使用計算機

編號： 70　　國立成功大學 111 學年度碩士班招生考試試題

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1. Consider the closed-loop system in Figure 1. Determine values of the parameters ***k*** and ***a*** so that the following specifications are satisfied: (25%)

(1) The steady-state error to a unit step input is zero.

(2) The closed-loop system has a percent overshoot less than 5%.

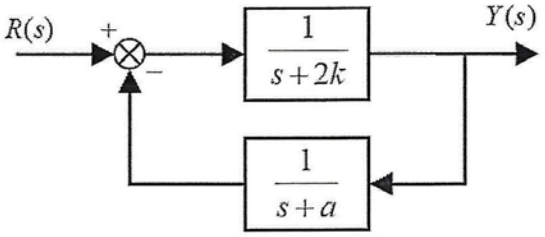

Figure 1. Closed-loop system with parameters ***k*** and ***a***.

2. For the system shown in Figure 2, do the following: (25%)

(1) Sketch the root locus

(2) Find the imaginary crossing and the corresponding gain, ***K***, at the crossing.

(3) Find the real-axis breakaway to two-decimal-place accuracy.

(4) Find the closed-loop zeros.

(5) Find the gain, ***K***, for a closed-loop step response with 30% overshoot.

(6) Discuss the validity of your second-order approximation.

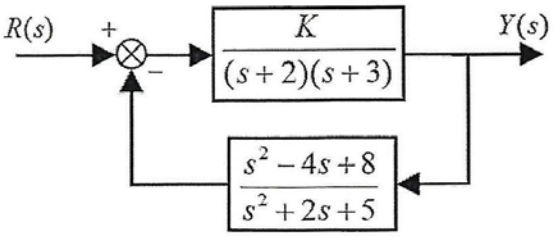

Figure 2. Closed-loop system in Problem 2.

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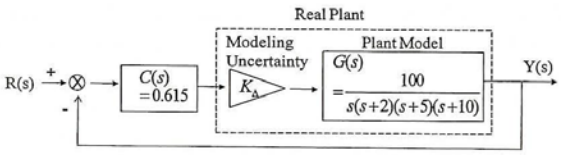
3. (25%)

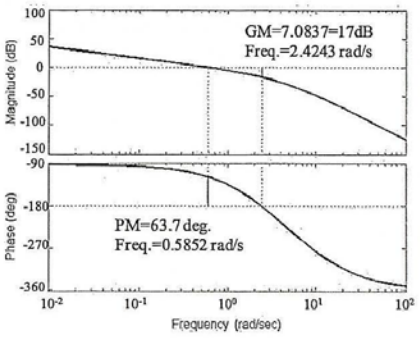
A feedback control system and the Bode plots of loop transfer function, $L(s)=G(s)C(s)$, are shown below, where K_Δ is the modeling uncertainty. In order to investigate what value of K_Δ can be tolerated in this feedback system to keep stable, please do the following analysis.

(1) (10%) Please draw the Nyquist plot of $L(s)$.

(2) (8%) Please draw the Nichols plot of $L(s)$

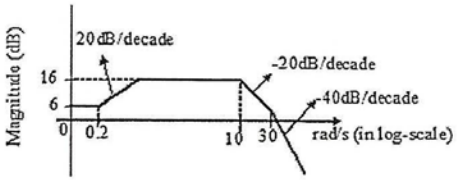
(3) (7%) Now, if K_Δ is a complex number and of the form, $K_\Delta = e^{-j\theta}$, and a control-engineer proposes a method called "phase loci" by varying θ to see how the roots change in the equation, $1+e^{-j\theta}G(s)C(s)=0$. Explain what would be the value of θ that makes the branch intersect the imaginary axis and the corresponding intercept value?





4. (25%)

The magnitude plot for a system is shown as,



(1) (10%) Assuming the corresponding system is a minimum-phase system, please estimate the transfer function.

(2) (10%) Based on the result of (1), sketch the phase plot.

(3) (5%) Based on the result of (1), determine the gain-margin and phase-margin.