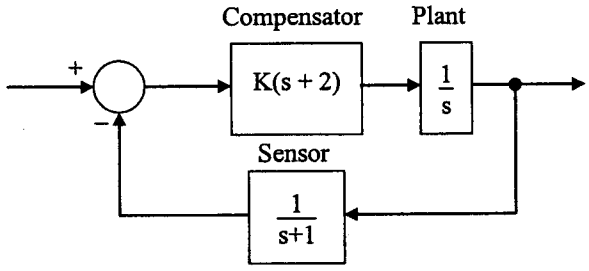
國立臺灣科技大學
九十四學年度碩士班招生考試試題
系所組別：高分子工程系碩士班丙組
科　　目：控制系統

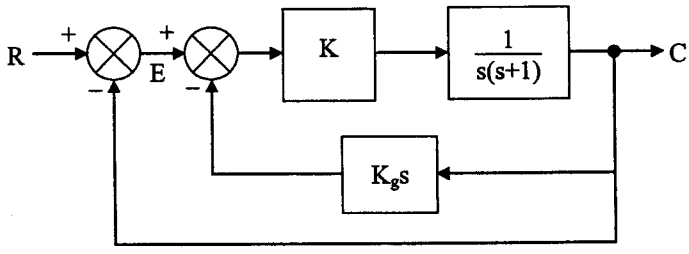
總分 100 分

1. Consider the system shown below, which contains a PD compensator and a sensor with dynamics.



(a) Accurately sketch the root locus for the system shown and fund the range of K, $0< K < \infty$, for which the system is stable, using the root locus. (5%)
(b) Find the range of K, $K > 0$, for which the roots of the system characteristic equation are all real. (5%)
(c) Use the results thus far to find the values of K for which the system is critically damped. (5%)

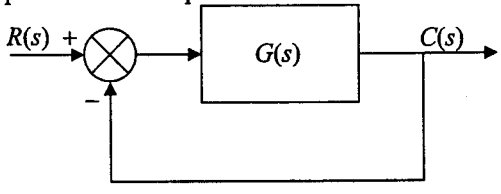
2. (a) For the motor position servo as shown without the rate or velocity feedback ($K_g = 0$), find K for a system damping ratio 0.5 and the corresponding steady-state error following unit ramp inputs. (5%)
(b) Still with $K_g = 0$, what value of K will give a steady-state unit ramp following error of 0.1 and what is the corresponding damping ratio? (5%)
(c) With K as in part (b), what value of K_g will give a system damping ratio of 0.5? How does the steady-state error compare with that in part (b)? (5%)



3. The unity feedback system is shown in the figure. Using the Routh-Hurwitz criterion, (20%)

(a) When $G(s) = \dfrac{K(s+1)}{s(s^3+4s^2+2s+3)}$, determine the range of values of K for which the closed-loop system is stable.

(b) When $G(s) = \dfrac{K(s+12)}{s(s^2+8s+25)}$, determine the value of K such that the closed-loop system has a pair of complex conjugate poles whose real part is -1 and find all the closed-loop poles.



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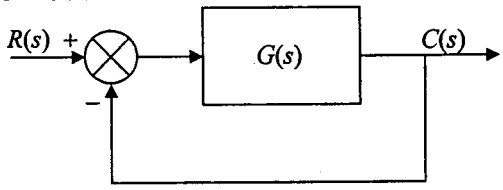
4. For the unity feedback system shown in the figure, where (20%)

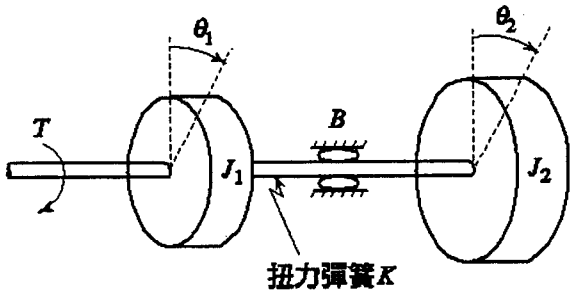
$$G(s)=\frac{K(s+5)}{s(s+2)(s+3)}$$

(a) Show that for $K=8$, the closed-loop poles are located at -4, $-0.5\pm3.12j$.

(b) For $K=8$, sketch the root locus to show the effect of variations δ of the open-loop pole at -2 on the closed-loop poles for $\delta>0$ and $\delta<0$. Which direction of variation is dangerous?



5. If system input is T and system output is θ_2, find the transfer function of the system. (15%)



6. The characteristic equation of a feedback control system is as follows.

$$1+\frac{K}{s(s+3)(s^2+2s+2)}=0,\quad K\geqq 0$$

Sketch the root locus of the system. (15%)

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