國立臺灣科技大學102學年度碩士班招生試題

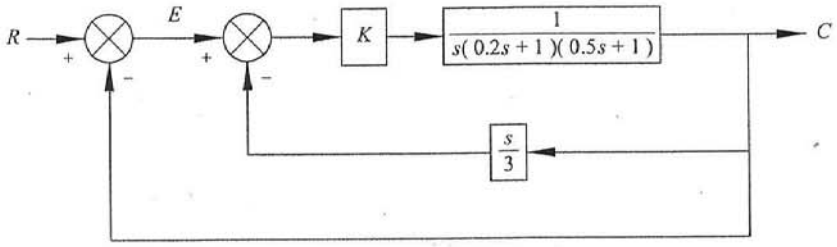
系所組別： 材料科學與工程系碩士班乙組

科　　目： 控制系統

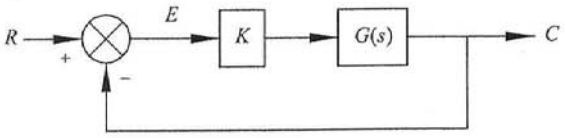
（總分為100分）

總分 100 分，共 6 大題。

1. In the system with rate feedback as shown below:
   (a) Sketch the loci and find K for a system damping ratio 0.5 for the dominating poles. (10%)
   (b) Find the steady-state errors for step and ramp inputs for K of part (a). (10%)



2. For the system shown below with $G(s)=(s+1)/[(s+2)(s+20)]$:
   (1) Find K so that the dominant system time constant will be $T=0.667$ sec, and for this K also determine the second pole of the system. (10%)
   (2) Calculate the unit step response for K of part (a). (5%)



3. Determine the output transform $Y(s)$ for the differential equation

$$\frac{d^3y}{dt^3}+3\frac{d^2y}{dt^2}-\frac{dy}{dt}+6y=\frac{d^2u}{dt^2}-u$$

where $Y(s)$ is the Laplace transform of $y(t)$, $y(t)$=output, $u(t)=\text{input}=5\sin t$, and initial conditions are

$$y(0^+)=\left.\frac{dy}{dt}\right|_{t=0^+}=0,\qquad \left.\frac{d^2y}{dt^2}\right|_{t=0^+}=1.$$

(15%)

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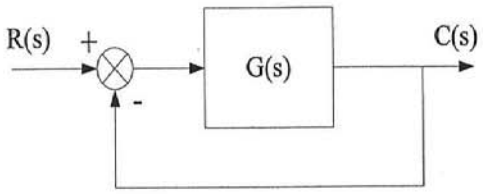
4. Consider the unity feedback system with

$$G(s)=\frac{K}{s(s+5)(s+15)}$$

(1) Find the location of the dominant poles for the system to operate with a 2.21-seconds settling time and an overshoot of 20%. (Use a 2% settling time) (5%)

(2) Design a PD controller to reduce the settling time by a factor of 4 while continuing to operate the system with 20% overshoot. (10%)

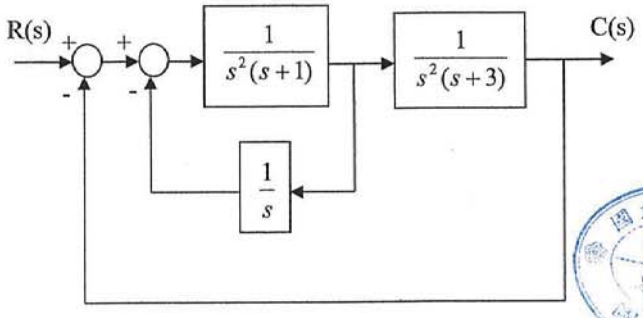


5. Given the system shown below, find the following:

(1) The closed-loop transfer function and the system type. (8%)

(2) The steady-state errors for a step input of $5u(t)$ and a ramp input of $5tu(t)$. (7%)

(3) Discuss the validity of your answers to part (b). (5%)



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6. Given the unity feedback system with

$$G(s)=\frac{K(s+1)}{s(s+2)(s+3)(s+4)}$$

do the following:

(1) Find the asymptotes, $j\omega$-axis crossing and the range of K for stability. Also sketch the root locus. (10%)

(2) Find the value of K for which the closed-loop transfer function will have a pole on the real axis at -0.5. (5%)