國立成功大學 109 學年度碩士班招生考試試題

系　　所：機械工程學系

考試科目：自動控制

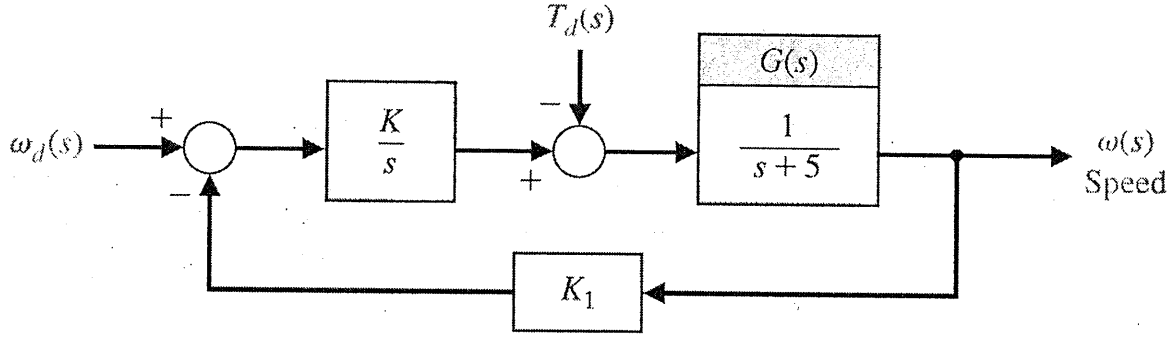
考試日期：0210，節次：1

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

1. **(25%)** Consider the system shown below,

   (1) (10%) Determine the range of K_1 allowable so that the steady state tracking error is $|e_{ss}| \leqq 1\%$.

   (2) (15%) Determine a suitable value for K_1 and K so that the magnitude of the steady-state error due to a disturbance $T_d(t)=2t$ (mrad/s, $0 \leqq t < 5$s), is less than 0.1 mrad/s .

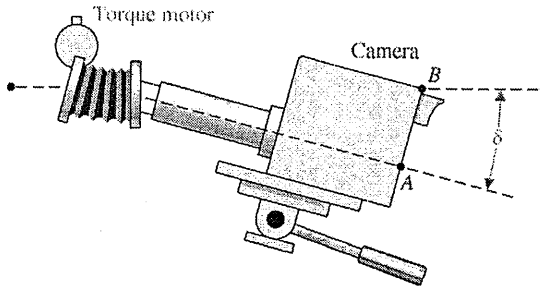


2. **(25%)** A dynalens is designed to reduce the effect of rapid scanning motion as shown below. A maximum scanning motion of 25°/s is expected. Let $K_g=K_t=1$ and assume that τ_g is negligible.

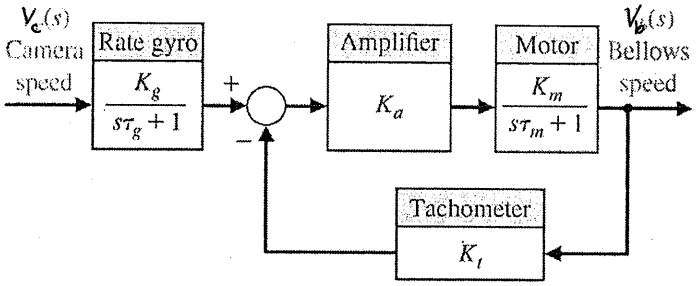
   (1) (5%) Derive the error of the system in s-domain, $E(s)$.

   (2) (10%) Determine the necessary loop gain $K_aK_mK_t$ when a 1°/s steady-state error is allowable.

   (3) (10%) The motor time constant $\tau_m=0.40$s. Determine the necessary loop gain so that the settling time (to within 2% of the final value of V_b) is $T_s \leqq 0.03$s.



(a)



(b)

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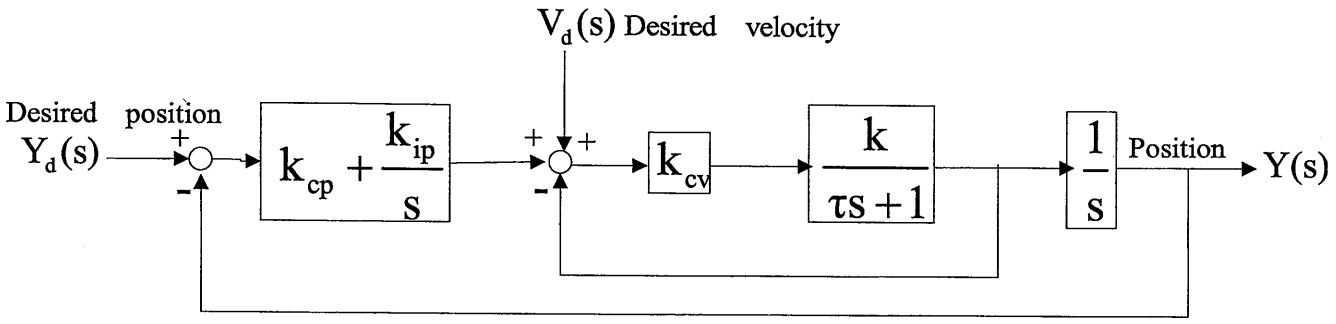
3. **(20%)** A positioning system is sketched below.



(1) **(10%)** Noting $V_d(s)=sY_d(s)$, obtain the transfer function $Y(s)/Y_d(s)$. Obtain the steady state error for $y_d(t)=a\cdot t$ where a is a constant.

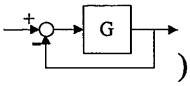
(2) **(10%)** Let $\tau=1$ and $k=10$. Find the values for k_{cv}, k_{cp} and k_{ip} so that three closed loop poles are at -9, $-6\pm 6j$. Fix k_{cp} and k_{ip} to the values that you found and obtain the root locus for k_{cv} varying from 0 to ∞.

4. **(30%)** The plant is described by

$$G(s)=\frac{1}{s}\cdot\frac{1-2s}{1+2s}$$

(1) **(10%)** Draw a unit step response of the plant (your sketch must include crucial information such as initial slope, final value, etc.)

(2) **(16%)** Sketch Bode and Nyquist plots of $G(j\omega)$.

(3) **(4%)** Is the unity feedback system () a minimum phase system? (Explain your answer.)