國立臺北科技大學

九十四學年度自動化科技研究所入學考試

自動控制試題

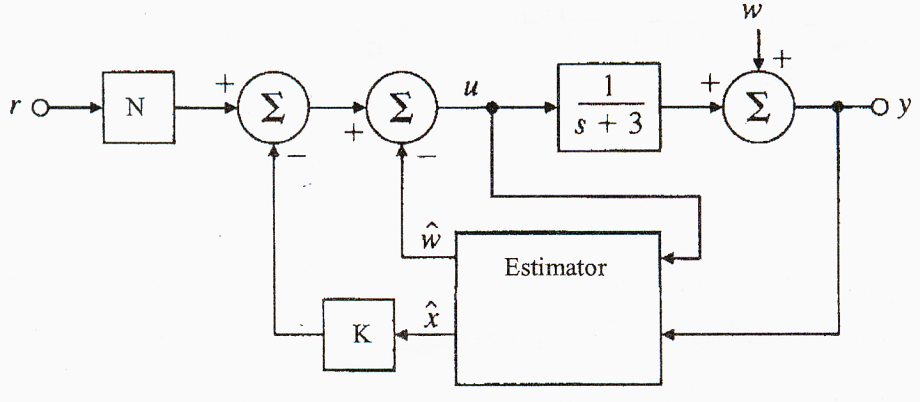
填准考證號碼

注意事項：

1. 本試題共 4 題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. When a system is subjected to an external disturbance w, one can estimate this equivalent disturbance, and add to the control a term $-\hat{w}$ that will cancel out the effects of the real disturbance in the steady state. In the figure below, a first order system $\frac{1}{s+3}$ under a constant disturbance w, we can describe the system as

$$\dot{w} = 0$$
$$\dot{x} = -3x + u + w$$
$$y = x$$

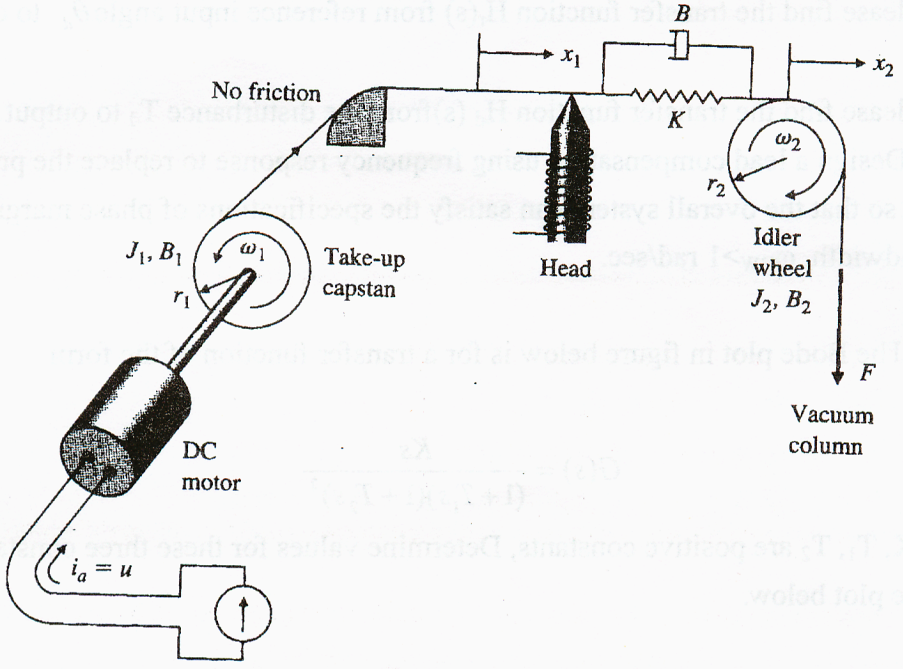


(1) (10%) Please construct an estimator to estimate the state x and disturbance w, with two estimator poles at $s = -15$.

(2) (10%) Please find the gain K so that the control pole at $s = -5$.

(3) (10%) Please find the feed forward gain N for a constant reference input so that the steady state error of the overall system can be eliminated.

2. A simplified sketch of a computer tape drive is given below



(1) (20%) Write the equations of motion in terms of the parameters listed below. K and B represent the spring constant and the damping of tape stretch, respectively, and ω_1 and ω_2 are angular velocities.

$J_1 = 4 \times 10^{-5}$ kg•m^2, motor and capstan

$B_1 = 1 \times 10^{-2}$ N•m•sec, motor damping

r1 $= 2 \times 10^{-2}$ m

$K_t = 3 \times 10^{-2}$ N•m/A, motor-torque constant

$K = 2 \times 10^4$ N/m

$B = 20$ N/m•sec

$r_2 = 2 \times 10^{-2}$ m

$J_2 = 1 \times 10^{-5}$kg•m^2

$B_2 = 1 \times 10^{-2}$N•m•sec, viscous damping, idler

$F = 6$N, constant force

$\dot{x}_1$ = tape velocity (variable to be controlled)

(2) (10%) Use the values in part (1) to write the equations in state-variable form as a set of first-order differential equations. Use (x_1,ω_1 ,x_2 ,ω_2) as state variables, and i_a as input variable.

注意：背面尚有試題

3. Consider a pendulum with control torque T_c and disturbance T_d whose differential equation is

$$\ddot{\theta} + 4\theta = T_c + T_d$$

Assume there is a potentiometer at the pin that measures the output angle θ, that is, y=θ, and the control torque T_c=$K_p(\theta_d - \theta)$, where θ_d is the reference input angle.

(1) (5%) Please find the transfer function $H_r(s)$ from reference input angle θ_d to output angle θ

(2) (5%) Please find the transfer function $H_d(s)$ from the disturbance T_d to output angle θ

(3) (15%) Design a lead compensation using frequency response to replace the proportional gain K_p so that the overall system can satisfy the specifications of phase margin PM>50° and bandwidth, ω_{BW}>1 rad/sec.

4. (15%) The Bode plot in figure below is for a transfer function of the form

$$G(s) = \frac{Ks}{(1+T_1 s)(1+T_2 s)^2}$$

where K, T_1, T_2 are positive constants, Determine values for these three constants from the bode plot below.