國立彰化師範大學103學年度碩士班招生考試試題

系所： 工業教育與技術學系 組別： 乙組(選考甲) 科目： 自動控制

☆☆請在答案紙上作答☆☆

1. The block diagram as shown in Fig. 1 represents a generic closed-loop linear system consisting of a reference input R(s), a disturbance D(s), and sensor noise N(s) and output C(s).

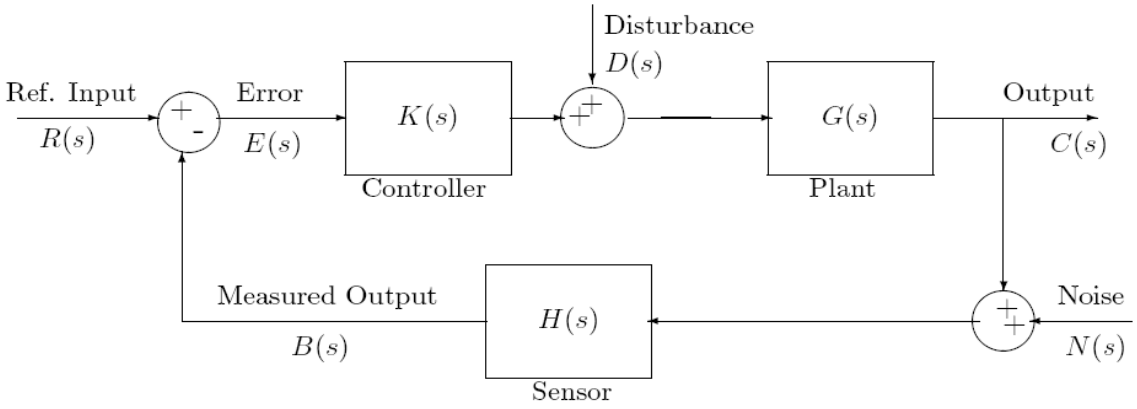

Fig. 1 Feedback Loop

(1) Evaluate the transfer functions relating the output C(s) to each of the inputs R(s), D(s), and N(s). (10%)

(2) Assume that H(s) = 1, K(s) = K, and there is no noise or disturbance (i.e. N(s)=0 and D(s) = 0). Derive a simple expression for the error E(s) = R(S) − B(s), in terms of R(s), G(s), and K. (5%)

(3) Consider the $G(s)=\frac{1}{S^2+2}$ and take R(s) as a unit step($R(s)=\frac{1}{S}$). Again, assume H(s) = 1, K(s) = K, N (s) = 0, and D(s) = 0. Use the Final Value Theorem to find the steady state value (i.e. as t goes to infinity) of the error. (5%)

2. For the system in Fig. 2.

(1) Plot the pole-zero pattern. (4%)

(2) Calculate the damping ratio ζ, the undamped natural frequency ω_n, the damped natural frequency ω_d, and the time constant T. (12%)

(3) Is this system overdamped, underdamped, or critically damped ? (4%)

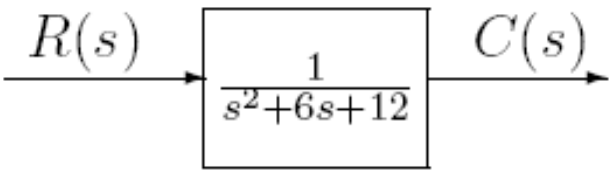

Fig. 2 Problem 2

3. In the following differential equation, where *x(t)* is the excitation and *y(t)* is the response

$$\frac{d^4 y(t)}{dt^4} + 10\frac{d^3 y(t)}{dt^3} + 20\frac{dy(t)}{dt} + 30y(t) = 40\frac{d^2 x(t)}{dt^2} + 5x(t)$$

Find the transfer function G(s) = Y(s)/X(s) where Y(s) and X(s) are the Laplace transformed versions of y(t) and x(t), respectively. (10%)

4. Please sketch the Bode diagrams for the following controllers

(1) PI controller given by $G_c(s) = 5(1 + \frac{1}{2s})$ (13%)

(2) PD controller given by $G_c(s) = 5(1 + 0.5s)$. (12%)

5. Consider the system shown in Fig. 3.

(1) Please draw a root-locus diagram. (15%)

(2) Determine the value of *k* such that the damping ratio of the dominant closed-loop poles is 0.4. (10%)

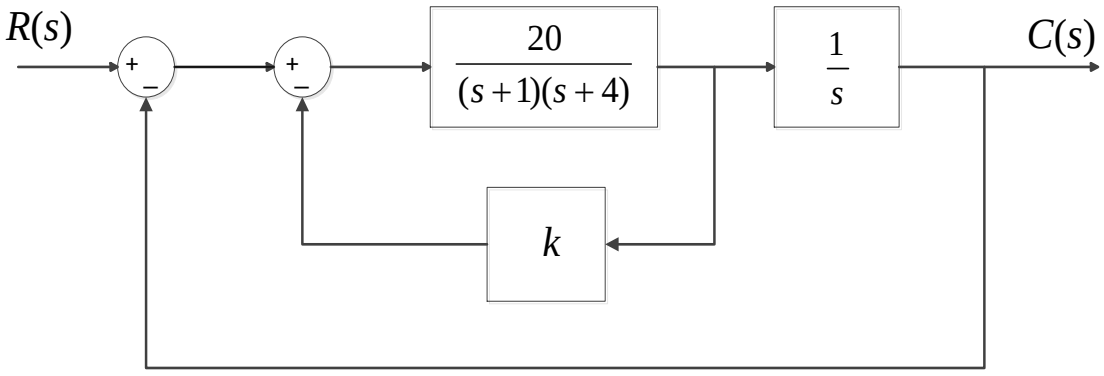

Fig. 3