Modern Control Systems

Assignment Translation

for the Fourth Lesson

Automatic Control Systems, Second Edition

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4. Given the following characteristic equations of control systems, determine if the systems are stable using the Routh-Hurwitz Criterion. If the system is not stable, find how many roots are there in the right-half s-plane. If there are roots symmetric with respect to the origin of the s-plane, find those roots.

(3) $s^5+2s^4+2s^3+4s^2+11s+10=0$ (4) $s^5+4s^4+8s^3+8s^2+7s+4=0$

5. (2) Given the following open-loop transfer function of a unity feedback control system, determine the condition that K must satisfy so that the system is stable.

$$G_0(s)=\frac{K(s+1)}{s(s-1)(s+5)}$$

8. Given the following open-loop transfer functions of unity feedback control systems, find the steady-state errors of the systems for input signals $r(t)=1(t)$ and $r(t)=t$.

(1) $G_0(s)=\dfrac{20}{(0.1s+1)(0.2s+1)}$ (2) $G_0(s)=\dfrac{200}{s(s+2)(s+10)}$

(3) $G_0(s)=\dfrac{5(3s+1)}{s^2(2s+1)(s+2)}$

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9. (4) Given the following transfer function of a closed-loop system, find the closed-loop poles of the system, and find the maximum overshoot $\sigma\%$ ($\sigma\%=0$ if there is no overshoot) and the settling time t_s of its unit-step response.

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

10. The step response of a unity feedback second order system is shown in Fig. T3.2. Please find the open-loop transfer function of the system.

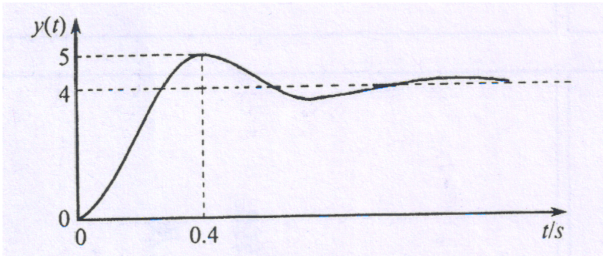

Fig. T3.2

11. The block diagram of a control system is shown in Fig. T3.3 (a), and its unit-step response is shown in Fig. T3.3 (b). Please determine k_1, k_2 and T.

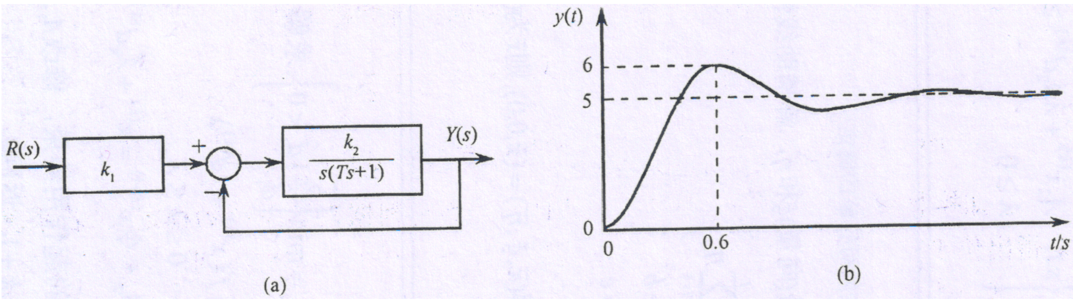

Fig. T3.3

12. Given the following step response of a unity feedback control system,

$$y(t) = 10[1 - 1.25e^{-1.2t}\sin(1.6t + 53.1^\circ)]$$

(1) if the steady-state error e_{ss} of the system satisfies $e_{ss} = 0$, find the closed-loop transfer function and the open-loop transfer function of the system;

(2) find the damping ratio ζ and the natural undamped frequency ω_n of the system;

(3) find the maximum overshoot $\sigma\%$ and the settling time t_s of the system.