Modern Control Systems

Assignment Translation

for the Second Lesson

Automatic Control Systems, Second Edition

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1. For the following differential equations of linear time-invariant systems, find the transfer functions $G(s) = Y(s)/U(s)$ of the systems, where $u(t)$ and $y(t)$ are the input and output of the system, respectively.

$$(1)\ y^{(3)}(t) + 3\ddot{y}(t) + 4\dot{y}(t) + y(t) = 2\dot{u}(t) + u(t)$$
$$(2)\ y^{(4)}(t) + 6\ddot{y}(t) + 10\dot{y}(t) + 3y(t) = 7u(t)$$
$$(3)\ y^{(3)}(t) + 2\ddot{y}(t) + 8\dot{y}(t) + y(t) + 5\int_0^t y(\tau)\,\mathrm{d}\tau = 3\dot{u}(t) + u(t)$$

2. Please find the transfer function of the circuit shown in Fig. T2.1 (b), where $u_i(t)$ and $u_o(t)$ are the input and output voltages, respectively.
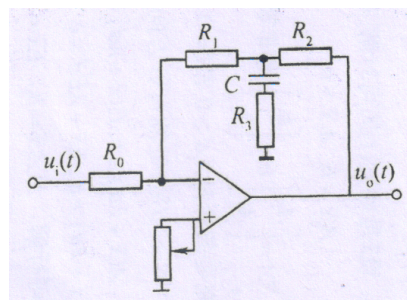

Fig. T2.1 (b)

3. In the mechanical system shown in Fig. T2.2 (c), $x_i(t)$ and $x_o(t)$ are the input and output displacement, respectively. In the schematic diagram, k_1, k_2 denote the stiffness coefficients of the springs and μ_1, μ_2 denote the friction coefficients of the dampers. Please find the differential equation and the transfer function of the system.
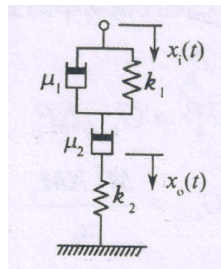
Fig. T2.2 (c)

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5. The signal-flow graph of a control system is shown in Fig. T2.4 (b). Please find the transfer function of the system.
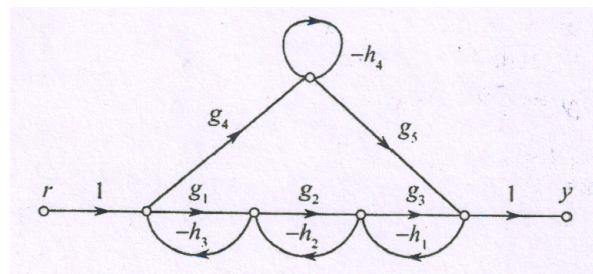

Fig. T2.4 (b)

6. The block diagram of a control system is shown in Fig. T2.5 (c). Please find the transfer function of the system.
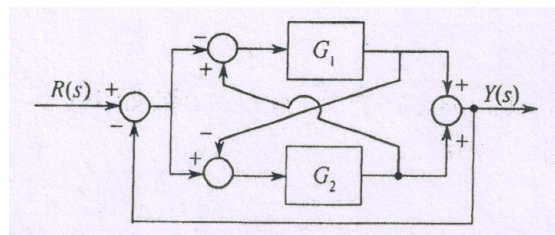

Fig. T2.5 (c)

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9. The block diagram of a system is shown in Fig. T2.8. Please find the following transfer functions: $\dfrac{Y_1(s)}{R_1(s)}, \dfrac{Y_2(s)}{R_1(s)}, \dfrac{Y_1(s)}{R_2(s)}, \dfrac{Y_2(s)}{R_2(s)}$.
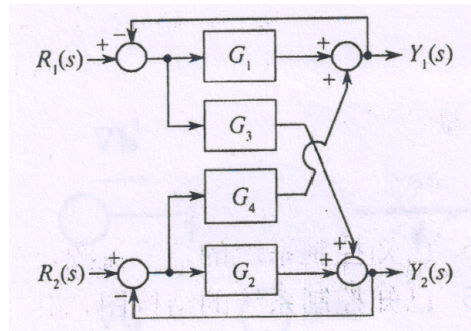
Fig. T2.8