Modern Control Systems

Assignment Translation

for the Third Lesson

Automatic Control Systems, Second Edition

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10. (3) Given the following differential equation of a control system, find the state equation and the output equation of the system.

$$y^{(3)}(t)+6\ddot{y}(t)+11\dot{y}(t)+y(t)=u^{(3)}(t)+8\ddot{u}(t)+17\dot{u}(t)+u(t)$$

12. (3) Given the following transfer function of a control system, find the state equation and the output equation of the system in both controllability canonical form and observability canonical form.

$$\frac{Y(s)}{U(s)}=\frac{s^3+8s^2+12s+9}{s^3+7s^2+14s+8}$$

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13. The state diagram of a control system is shown in Fig. T2.9 (b), where x_1, x_2, x_3 are state variables and u, y are the input and output of the system, respectively. Please find the state equation and the output equation of the system.

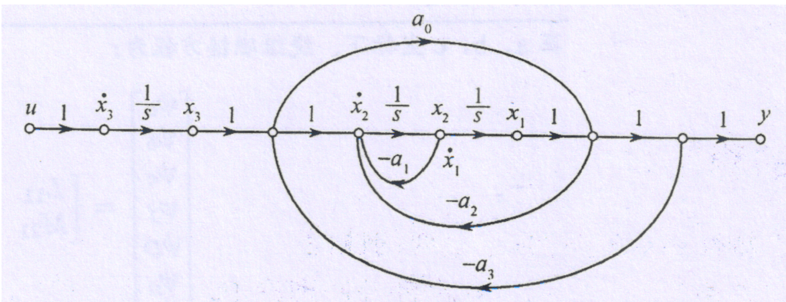

Fig. T2.9 (b)

15. In the circuit shown in Fig. T2.11, u_i and u_o are the input and output variables,

respectively. In this circuit, u_C and i_L are state variables with initial conditions $u_C(0)$ and $i_L(0)$. Please sketch the state diagram of the circuit and find the state equation and the output equation.

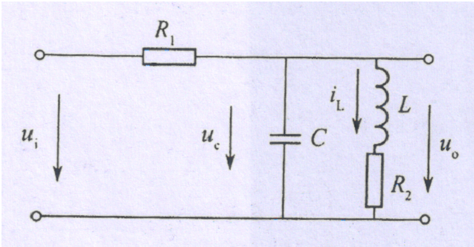

Fig. T2.11

17. (3) In the state equation $\dot{\mathbf{x}}(t) = \mathbf{A}\mathbf{x}(t)$ of a linear time-invariant system, the matrix $\mathbf{A}$ is given as follows. Please find the state-transition matrix $\mathbf{\Phi}(t)$ of the system using Laplace transform.

$$\mathbf{A} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

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1. (2) Please find the transfer function of the following system, and determine if the system is asymptotic stable and BIBO stable.

$$\dot{\boldsymbol{x}} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 250 & 0 & -5 \end{bmatrix} \boldsymbol{x} + \begin{bmatrix} 0 \\ 0 \\ 50 \end{bmatrix} u$$
$$y = \begin{bmatrix} -5 & 1 & 0 \end{bmatrix} \boldsymbol{x}$$