第1頁,共1頁

1. Find the transfer function Y(s)/R(s) for each of the systems.

(a)
$$\frac{d^3y(t)}{dt^3} + 2\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = 3\frac{dr(t)}{dt} + r(t)$$
 (10%)

(b)
$$\frac{d^3 y(t)}{dt^3} + 10 \frac{d^2 y(t)}{dt^2} + 2 \frac{dy(t)}{dt} + y(t) + 2 \int_0^t y(\tau) d\tau = \frac{dr(t)}{dt} + 2r(t)$$
 (10%)

2. Using Mason's gain formula, determine $e_c(s)/e(s)$ for the system shown in Fig.1. (15%)



Fig. 1

3. Given the system

$$\frac{dx(t)}{dt} = \begin{bmatrix} 0 & 1\\ -1 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 1\\ 2 \end{bmatrix} u(t), \ y(t) = \begin{bmatrix} 1 & 1 \end{bmatrix} x(t)$$

- (a) Determine the controllability and observability of the system. (15%)
- (b) Let u(t) = -Kx(t), where $K = [k1 \ k2]$. Determine the conditions on k1 and k2 so that the closed-loop system is observable. (10%)
- 4. The forward-path transfer function of a unity-feedback control system is given in the following.

$$G(s) = \frac{K}{s(1+0.1s)(1+0.5s)}$$

- (a) Apply the Nyquist criterion to determine the range of K for stability. (10%)
- (b) Check the answer obtained in part (a) with the Routh-Hurwitz criterion. (10%)
- (c) Find the value of K so that the gain margin of the system is 20 dB. (10%)
- (d) Find the value of K so that the phase margin of the system is 45° . (10%)