科目	控制系統	適用系所	自動控制工程學系	時間	100 分鐘

※請務必在答案卷作答區內作答。

1. Consider an open-loop system shown in Fig. 1.
   (a) When $R(s)=\frac{4}{s^2+4}$ and $y_{ss}(t)=\sqrt{5}\sin(\omega t+\theta)$, find k, ω and θ. (5%)
   (b) Define $M(s)=\frac{G(s)}{1+G(s)}$, where $G(s)=\frac{k}{(s+2)(s+5)}$, find k such that the poles of $M(s)$ have damping ratio $\zeta=0.5$. (5%)
   (c) Find the band-width (B.W.) of the system. (5%)
   (d) Find resonant peak M_r and resonant frequency ω_r. (5%)

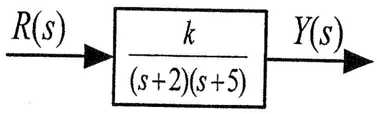

Fig. 1

2. Consider one unity negative feedback control system with open-loop transfer function:

$$G(s)=\frac{k(s+10)}{s(s+1)(s+5)}$$

   (a) Find the value of k such that the closed-loop system has gain margin G.M. = 6dB. (5%)
   (b) Find the value of k such that the closed-loop system has phase margin P.M. = 30°. (5%)

3. Consider the control system shown in Fig. 2. Suppose that the system has poles $s=-1\pm\sqrt{3}j$.
   (a) Find the values of k and a. (5%)
   (b) When $r(t)=1+2t$, calculate the $e_{ss}(t)$. (5%)

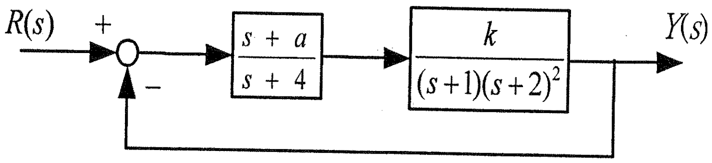

Fig. 2

4. Consider the control system shown in Fig. 3. Sketch the root-locus of the closed-loop system with $k>0$. (10%)

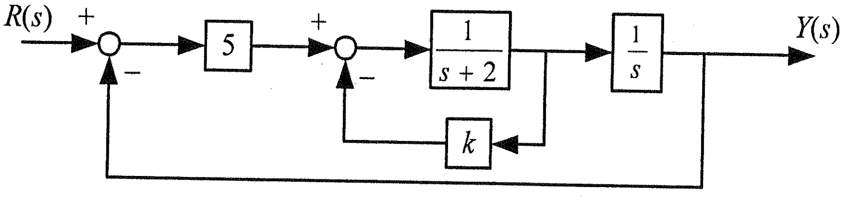

Fig. 3

5. Consider the network shown in Fig. 4.
   (a) Find the state equation of the network. (5%)

(b) Find the equilibrium state of the system. (5%)
(c) Is the equilibrium state asymptotically stable? (5%)

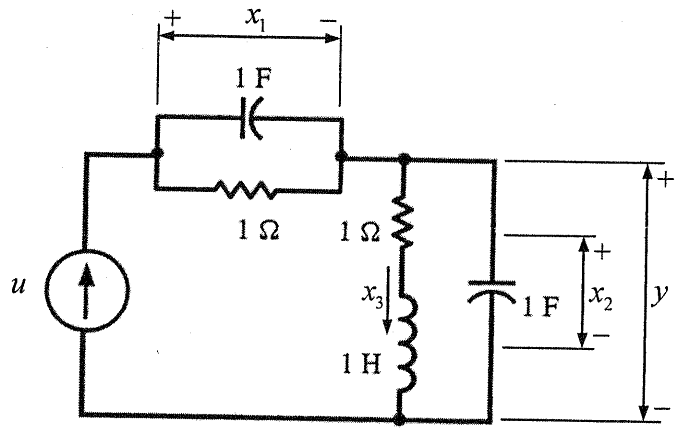

Fig. 4

6. Consider the following dynamic system:

$$4\ddot{y}+32\dot{y}+60y=3\dot{u}+2u$$

Determine the transfer function $M(s)$ such that the unit-step response of $M(s)$ is equivalent to the free response of $y(t)$ for the initial conditions $y(0)=4$ and $\dot{y}(0)=0$. (10%)

7. Consider the following state equation:

$$\dot{\mathbf{x}}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -1 & -3 & -3\end{bmatrix}\mathbf{x}+\begin{bmatrix}1\\0\\0\end{bmatrix}u$$
$$y=\begin{bmatrix}1 & 2 & 1\end{bmatrix}\mathbf{x}$$

(a) Is the system controllable? (5%)
(b) Is the system observable? (5%)

8. Consider the network shown in Fig. 5.
(a) Find the transfer function of the network. (5%)
(b) Is it BIBO stable? (5%)
(c) Find the output response $y(t)$ if the input is $u(t)=\sin t$. (5%)

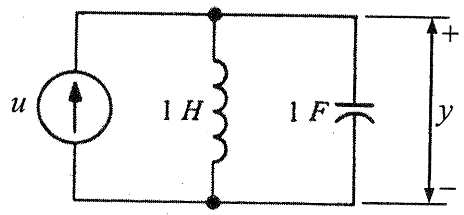

Fig. 5