國立高雄海洋科技大學 100 學年度碩士班考試入學
輪機工程研究所—自動控制學試題(※不須使用計算機)

1. (10%) Consider the following differential equation:

$$\frac{d^3y(t)}{dt^3}+5\frac{d^2y(t)}{dt^2}+\frac{dy(t)}{dt}+2y(t)=u(t)$$

Find the state equation expressed by a vector-matrix form $\frac{d\mathbf{x}(t)}{dt}=\mathbf{Ax}(t)+\mathbf{B}u(t)$

under the assumption of $x_1(t)=y(t)$, $x_2(t)=\frac{dy(t)}{dt}$, and $x_3(t)=\frac{d^2y(t)}{dt^2}$.

2. (16%) Find the inverse Laplace transform f(t) of the following functions:

(a) $F(s)=\frac{6s^2+26s+26}{(s+1)(s+2)(s+3)}$, (b) $F(s)=\frac{100(s+25)}{s(s+5)^3}$.

3. (14%) Consider the block diagram of a multi-variable control system shown in Fig. 1:

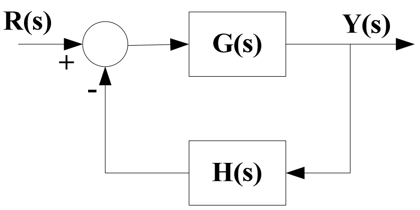

Fig. 1

Find the closed-loop transfer matrix under $\mathbf{G}(s)=\begin{bmatrix}\frac{1}{s+1} & -\frac{1}{s}\\ 2 & \frac{1}{s+2}\end{bmatrix}$ and $\mathbf{H}(s)=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$.

4. (20%) For the feedback system of Fig.1 with $G(s)=K\frac{(s-2)(s-4)}{(s+2)(s+4)}$, $\mathbf{H}(s)=1$.

(a) Sketch the root locus for $K>0$.

(b) Find the breakaway and break-in points.

(c) Find the frequency and gain at imaginary-axis crossing.

(d) Determine the range of K to ensure stability.

5. (20%) For the feedback system of Fig.1, with $\mathbf{H}(s)=1$ and

(a) $G(s)=\dfrac{1}{s^5+s^4+2s^3+2s^2+2s}$,

(b) $G(s)=\dfrac{3}{s^5+3s^4+2s^3+6s^2+s}$.

Find the number of poles for the closed-loop system in the right half plane, the left plane, and on the jw-axis with (a) and (b), respectively.

6. (20%) For the feedback system of Fig. 1 with $G(s)=K\dfrac{(s+6)}{s(s+2)(s+4)}$, $\mathbf{H}(s)=1$.

(a) Sketch the root locus for $K>0$.

(b) In order to obtain the finite steady state error, which signal should be used? (step, ramp, and parabola)

(c) Find the value of K to achieve that the steady state error equal to 0.3 for unit test signal.