1. Diagonalize the matrix A where

(20%)
$$A = \begin{bmatrix} 0 & 6 & -5 \\ 1 & 0 & 2 \\ 3 & 2 & 4 \end{bmatrix}$$

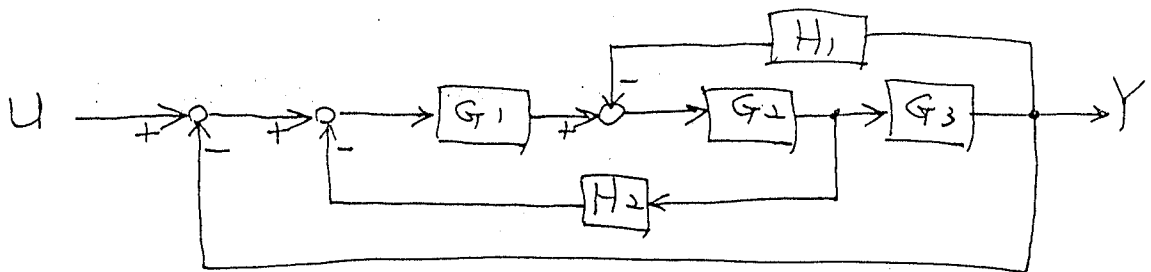Find the transform matrix P that transform A into Jordan canonical form.

2. The Laplace transform of $f(t)$ is given by

(10%)
$$F(s) = \frac{(s+1)\, e^{-7s}}{s^2 (s+5)}$$

Find $f(t)$.

3. For the system shown below, determine

(10%) the transfer function $Y(s)/U(s)$.

4. Sketch the root locus of the system, whose

(20%) transfer function is

$$KGH = \frac{K}{s(s+3)(s^2 + 6s + 64)}$$

Also, find the maximum value of K for which the system is stable.

(背面仍有題目,請繼續作答)

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5.
(20%) The system is given by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 3 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}.$$

The output is

$$y = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

a) Show that the system is not completely observable.

b) Show that the system is completely observable if the output is given by

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}.$$

6.
(20%) A block diagram of a velocity servomechanism is shown below. For the input voltage 5 V, determine the steady-state error in the velocity $\dot{\theta}$.