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1. (15 points)Three different systems can be described as (a) s (b) $\frac{1}{s}$ (c) e^{-s}, respectively.
If the input signal is $\sin t$, please find and plot the output signals of above systems, respectively.

2. (15 points)The dynamic equation as following

$$\dot{x}=\begin{bmatrix}1&1&0&0&0&0&0\\0&1&0&0&0&0&0\\0&0&1&0&0&0&0\\0&0&0&1&0&0&0\\0&0&0&0&3&1&0\\0&0&0&0&0&3&0\\0&0&0&0&0&0&3\end{bmatrix}x+\begin{bmatrix}2&1&1\\2&1&1\\1&1&1\\3&2&1\\-1&0&0\\1&0&1\\1&0&0\end{bmatrix}u(t)$$

$$y=\begin{bmatrix}2&2&1&3&1&2&1\\1&1&1&2&0&0&0\\1&1&1&1&0&1&0\end{bmatrix}x$$

Please check its controllability and observability and you have to write down the procedure of your work.

3. (20 points) For each of the following systems, determine whether or not the system is (i) linear (ii) causal (iii) time invariant?
The input-output relationship is described as following

(a) $y(t)=\int_0^t u(\tau)d\tau \qquad t\geq 0$

(b) $y(t)=\int_0^{t+2} u(\tau-2)d\tau$

$u(t)$ is the system input and $y(t)$ is the system output.
(You have to write down your reasons, not just by guess!)

(背面仍有題目,請繼續作答)

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4. (50 points, 5 points each) Answer the following questions:

(I) Find a nonlinear element and plot its input-output relationship.

(II) Show that the distinct eigenvalues associated eigenvectors are linearly independent.

(III) Show the definitions of Phase margin and Gain margin.

(IV) Explain why a state feedback will not alter controllability property and may alter the observability property of the system.

(V) Show the difference between continuous/discrete and analog/digital signals.

(VI) Explain the impulse response and transfer function of a system.

(VII) Show the advantages and disadvantages between analog and digital controller.

(VIII) Show the meanings of zero-state response and zero-input response.

(IX) The state equation, $\dot{x}(t) = Ax(t) + Bu(t)$, please write down your procedure " How to check its stability".

(X) Show an example of system control theory to biomedical applications.