國立成功大學

114學年度碩士班招生考試試題

編　號：85

系　所：工程科學系

科　目：訊號與系統

日　期：0211

節　次：第 2 節

注　意：1.不可使用計算機
2.請於答案卷(卡)作答，於試題上作答，不予計分。

1. Fig. 1 is a first order RC circuit.

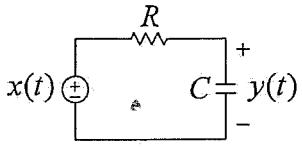

Fig.1 A first order RC circuit.

(a) (20 %) The unit step response of this circuit is

$$y(t) = (1 - e^{\frac{-t}{RC}})u(t)$$

where $x(t) = u(t)$. Let input $x(t)$ is the impulse function $\delta(t)$, find the output $y(t) = ?$

(b) (20 %) We have known the differential equation of this circuit is

$$\frac{dy(t)}{dt} + \frac{1}{RC}y(t) = \frac{1}{RC}x(t)$$

where $RC = 0.2$ s and initial condition $y(0^-) = -1$. Let $x(t) = \frac{2}{5}e^{-2t}$, please use the one-sided Laplace transform and inverse Laplace transform to find the output $y(t) = ?$

2. Fig. 2 shows the input-output transfer curves of system 1 and system 2.

(a) (10 %) Is the system 1 linear? Prove it.

(b) (10 %) Is the system 2 linear? Prove it.

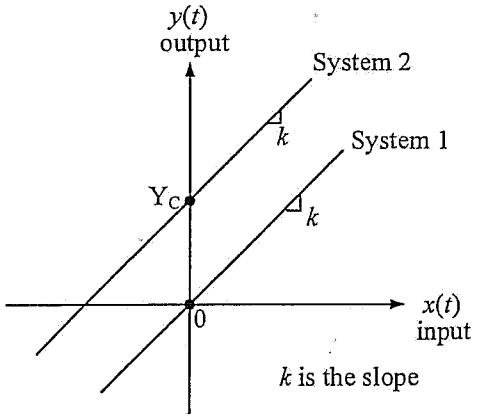

Fig. 2 Transfer curves of systems.

3. (10 %) Give examples to explain a system is causal or non-causal.

4. (10 %) Let the discrete-time signal $x[n]$ is

$$x[n] = \left(n\left(\frac{1}{2}\right)^n u[n]\right) * \left(\left(\frac{1}{4}\right)^{-n} u[-n]\right)$$

where $u[n]$ is discrete-time unit step sequence and '*' denotes the convolution.
Please find the z-transform of $x[n]$.

5. (10 %) Let $x(t)=e^{-t}u(t)$ and $h(t)=\delta(t+1)-\delta(t)+3\delta(t+3)$, where $u(t)$ is the unit step function and $\delta(t)$ is the impulse function. Please find $y(t)=x(t)*h(t)=?$ ('*' denotes the convolution)

6. (10 %) Fig.3 shows the two discrete-time signals $x[n]$ and $h[n]$. Please find $y[n]=x[n]*h[n]=?$ ('*' denotes the convolution)

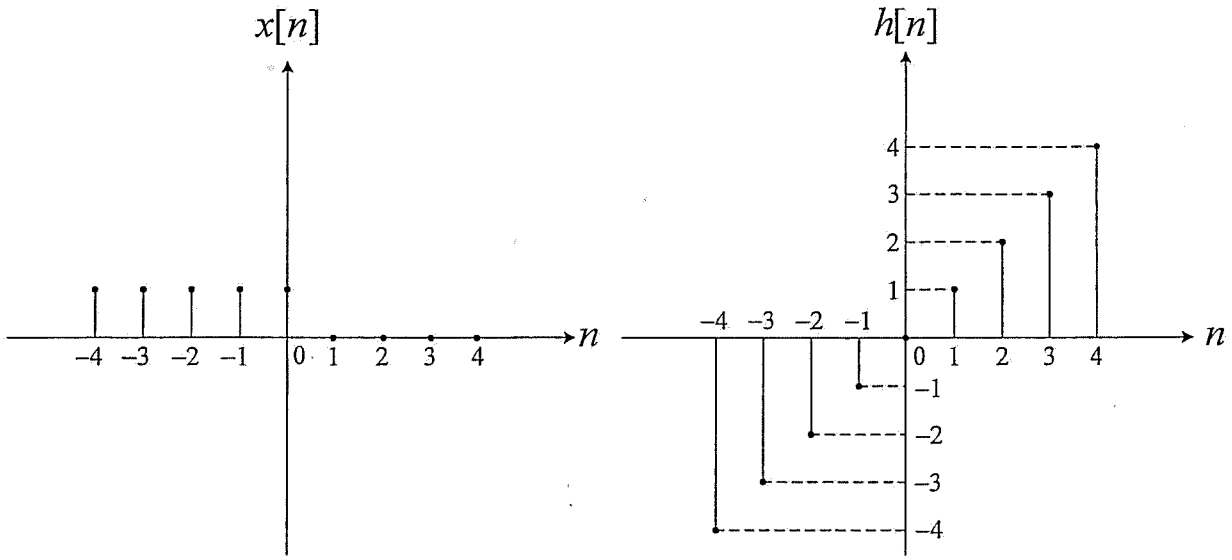

Fig.3 Discrete-time signals $x[n]$ and $h[n]$.