科目：訊號與系統(500B)　　校系所組：中央大學電機工程學系（系統與生醫組）
清華大學電機工程學系（乙組、丁組）

一. Consider a discrete-time, causal LTI system with input $x[n]$ and output $y[n]$. The system is described by the following pairs of difference equations, involving an intermediate signal $w[n]$:

$$y[n]-\frac{5}{4}y[n-1]+w[n]+\frac{1}{4}w[n-1]=\frac{1}{10}x[n]$$

$$y[n]-\frac{3}{2}y[n-1]+2w[n]=-\frac{2}{5}x[n]$$

(一) (3%)Derive the frequency response of this system.

(二) (3%)Derive the impulse response of this system.

(三) (4%)Find a single difference equation relating $x[n]$ and $y[n]$.

二. Given the following second-order causal, stable LTI system

$$7\frac{d^2y(t)}{dt^2}+28\frac{dy(t)}{dt}+28y(t)-x(t)-4\frac{dx(t)}{dt}=0$$

(一)(3%) Find the frequency response of this system.

(二)(4%) Find the corresponding impulse response.

(三)(3%) Determine whether this system is over-damped, critically damped, or under-damped.

三. (20%) Consider a continuous-time low-pass filter $h(t)$ with its Fourier spectrum $H(j\omega)$, whose magnitude spectrum and phase spectrum are shown in Fig. 1. Please determine $h(t)$ by means of inverse Fourier Transform.

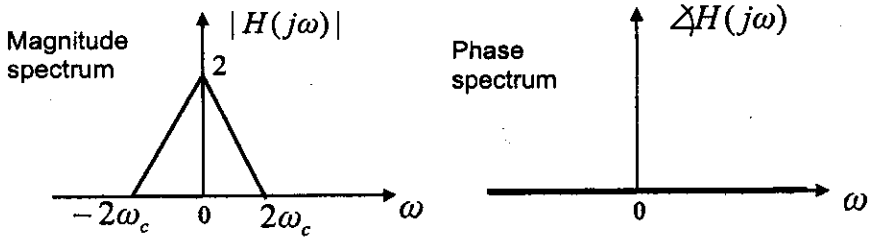

Figure 1.

四. (一)(10%) Consider a continuous-time linear time-invariant system with impulse response $h(t)=e^{-t}u(t)$. Determine the output $y(t)$ of the system when the input is $x(t)=u(t+1)-u(t-1)$.

(二)(10%) Consider a discrete-time linear time-invariant system with unit sample response $h[n]=r^n u[n]$, where $0<r<1$. Determine the step response $s[n]$ of this system.

注意：背面有試題

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五. Please determine the z-transform or the inverse z-transform of the following signals.

(一)(10%) Please find the z-transform of the signal $x[n]$,

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

where $u[n]$ is discrete-time unit-step function, and * denotes the discrete-time convolution operator.

(二)(10%) Please find the inverse z-transform of $X(z)$,

$$X(z)=\left(\frac{1}{1-az^{-1}}\right)^2$$

六. Given a linear time-invariant (LTI) system with system function $H(s)=\frac{s-1}{(s+1)(s-2)}$, please determine the impulse response $h(t)$ and show its corresponding region of convergence (ROC) if

(一)(10%) the system is known to be causal;

(二)(10%) the system is known to be stable.