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Glasgow College, UESTC

Signals and Systems—Semester 2, 2017 - 2018

Quiz 2

May, 2018

Notice: Please make sure that both your UESTC and UoG Student IDs are written on the top of every sheet. This examination is closed-book and the use of a cell phone is not permitted. All scratch paper must be adequately labeled. Unless indicated otherwise, answers must be derived or explained clearly. Please write within the space given below on the answer sheets.

All questions are compulsory. There are 5 questions and a maximum of 100 marks in total.

The following table is for grader only:

Question	1	2	3	4	5	Total	Grader
Score							

Score

Question1 (20 points) Each of the following questions may have only one right answers, justify your answers and write it in the blank.

(1) Let $x_1(t) = e^{|t|}$ and $x(t) = x_1(t) * \sum_{k=-\infty}^{+\infty} \delta(t-4k)$. The Fourier series coefficients of $x(t)$ may be ( ).

(a) $a_{-k} = a_k$ and $Im\{a_k\} = 0$ (b) $a_k = -a_k$ and $Im\{a_k\} = 0$

(c) $a_{-k} = a_k$ and $Re\{a_k\} = 0$ (d) $a_k = -a_k$ and $Re\{a_k\} = 0$

(2) Consider two signals $x_1(t)$ and $x_2(t)$, as known in Figure 1. The Fourier transform of $x_1(t)$ is $X_1(jw)$. Then the Fourier transform of $x_2(t)$ should be ( ).

(a) $X_1(-jw)e^{-3jw}$ (b) $X_1(jw)e^{-3jw}$ (c) $X_1(-jw)e^{3jw}$ (d) $X_1(jw)e^{3jw}$

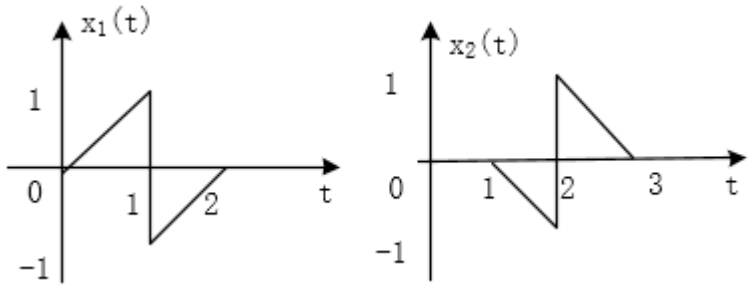

Figure1

(3) Suppose the highest frequency of $x(t)$ is $w_m = 10^4\pi$ rad/s and let $x_p(t) = \sum_{n=-\infty}^{+\infty} x(nT)\delta(t-nT)$. If $x(t)$ can be correctly recovered from $x_p(t)$, then the sampling period T and the cut-off frequency of the low-pass filter are ( )

(a) $10^{-4}s,10^{4}Hz$ (b) $10^{-4}s,5\times10^{3}Hz$ (c) $5\times10^{-3}s,5\times10^{3}Hz$ (d) $5\times10^{-3}s,10^{4}Hz$

(4) A signal $x(t)=4\cos(3\pi t)+2\sin(\pi t)$ is inputted to a system with the impulse response $h(t)=\dfrac{\sin(2\pi t)}{\pi(t)}$ .The output $y(t)=x(t)*h(t)=$( )

(a) $2\sin(\pi t)$ (b) $4\cos(3\pi t)$ (c) $4\cos(3\pi t)+2\sin(\pi t)$ (d) 0

Score

Question2 (20 points) Consider an LTI system with unit impulse response $h(t)=\dfrac{\sin\pi t}{\pi t}\cos 4\pi t$, if the input is $x(t)=1+\cos 2\pi t+\sin 4\pi t+\dfrac{\sin 4\pi t}{\pi t}$, determine the output $y(t)$.

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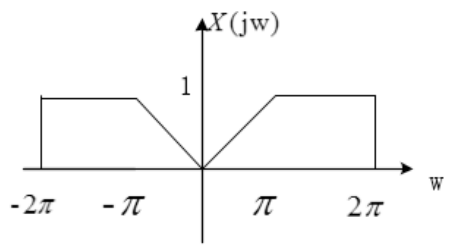
Question3 (20points) Consider the system illustrated in Figure 2, if we know $h_1(t)=\frac{\sin 5\pi t-\sin 4\pi t}{\pi t}$ and $h_2(t)=\frac{\sin \pi t}{\pi t}$, sketch the spectrum of $r_1(t)$, $r_2(t), r_3(t)$ and $y(t)$.



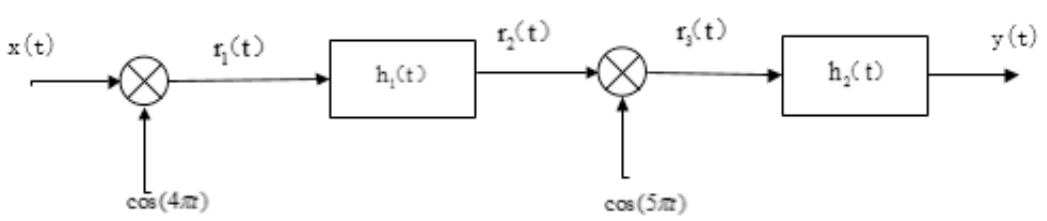


Figure2

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Question4 (20 points) It is known that $x(t) \overset{FT}{\leftrightarrow} X(jw) = \mathrm{Re}\{X(jw)\} + j\,\mathrm{Im}\{X(jw)\}$, and $x(t)$ is shown as Figure 3.

(a) $r(t) \overset{FT}{\leftrightarrow} \mathrm{Re}\{X(jw)\}$, where $\mathrm{Re}\{X(jw)\}$ is the real part of $X(\mathrm{jw})$. Please sketch $\mathrm{r}(t)$.

(b) Find the value of $\int_{-\infty}^{+\infty} X(\text{-jw})dw$.

(c) Let $Y(\mathrm{jw}) = X(-jw/3)e^{-jw}$, and $\mathrm{y}(t) \overset{FT}{\leftrightarrow} Y(jw)$. Sketch $\mathrm{y}(t)$.

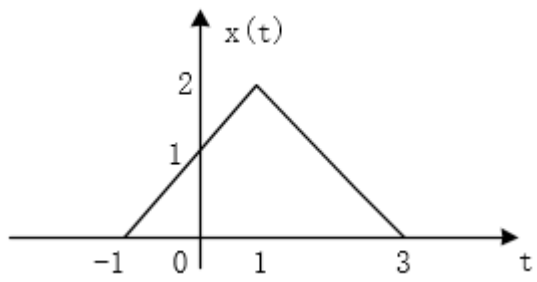

Figure 3

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Question5 (20 points) Suppose the unit impulse response of a LTI system is $h(t)=\left[\frac{d}{dt}\delta(t)\right]*\frac{\sin 3\pi t}{\pi t}$.

(a) Determine the expression of the frequency response $H(jw)$.

(b) Determine the value of $\int_{-\infty}^{\infty}h^2(t)dt$.

(c) * Determine the convolution integral $y(t)=\left[\sum_{k=0}^{\infty}\left(\frac{1}{k+1}\right)\sin(2k\pi t)\right]*h(t)$.