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10EC44

Fourth Semester B.E. Degree Examination, Dec.2013/Jan.2014

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Sketch the even and odd part of the signal shown in Fig.Q1(a). **(06 Marks)**

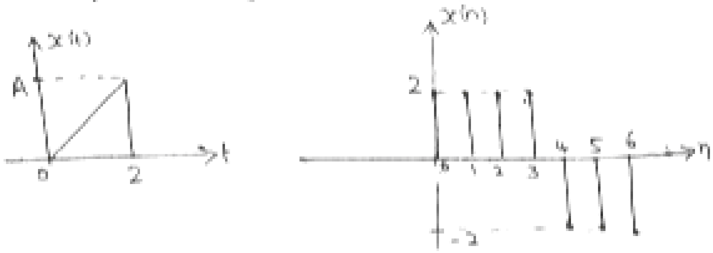

Fig.Q1(a)

b. Check whether the following signals is periodic or not and if periodic find its fundamental period.

(i) $x(n) = \cos(20\pi n) + \sin(50\pi n)$ (ii) $x(t) = [\cos(2\pi t)]^2$ **(06 Marks)**

c. Let x(t) and y(t) as shown in Fig.Q1(c). Sketch (i) $x(t)y(t-1)$ (ii) $x(t)y(-t-1)$ **(08 Marks)**

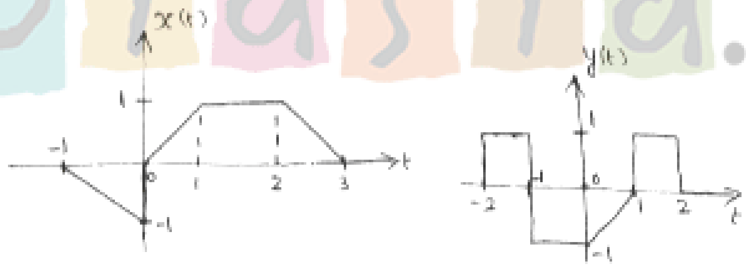

Fig.Q1(c)

2 a. Determine the convolution sum of the given sequences

$x(n) = \{1, \underset{\uparrow}{-2}, 3, -3\}$ and $h(n) = \{-2, \underset{\uparrow}{2}, -2\}$ **(04 Marks)**

b. Perform the convolution of the following sequences:

$x_1(t) = e^{-at}$; $0 \le t \le T$

$x_2(t) = 1$; $0 \le t \le 2T$ **(10 Marks)**

c. An LTI system is characterized by an impulse response, $h(n) = \left(\frac{1}{2}\right)^n u(n)$. Find the response of the system for the input $x(n) = \left(\frac{1}{4}\right)^n u(n)$. **(06 Marks)**

3 a. Determine the following LTI systems characterized by impulse reponse is memory, causal and stable.

(i) $h(n) = 2u(n) - 2u(n-2)$ (ii) $h(n) = (0.99)^n u(n+6)$. **(06 Marks)**

b. Find the natural response of the system described by a differential equation

$$\frac{d^2y(t)}{dt^2} + 2\frac{dy(t)}{dt} + 2y(t) = 2x(t), \text{ with } y(0) = 1, \text{ and } \left.\frac{dy(t)}{dt}\right|_{t=0} = 0$$ **(06 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

c. Find the difference equation description for the system shown in Fig.Q3(c). **(04 Marks)**

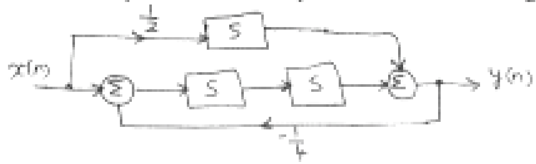

Fig.Q3(c)

d. By converting the differential equation to integral equation draw the direct form-I and direct form-II implementation for the system as

$$\frac{d^3y(t)}{dt^3} + 4\frac{d^2y(t)}{dt^2} + 2\frac{dy(t)}{dt} = x(t) + 6\frac{d^2x(t)}{dt^2}$$ **(04 Marks)**

4 a. State and prove the following properties of DTFS: (i) Modulation (ii) Parseval's theorem. **(10 Marks)**

b. Find the Fourier series coefficients of the signal x(t) shown in Fig.Q4(b) and also draw its spectra. **(10 Marks)**

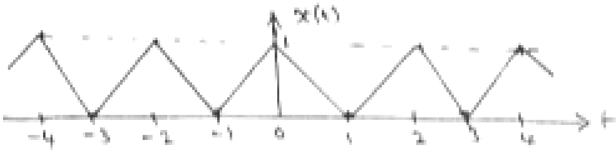

Fig.Q4(b)

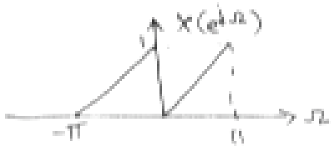

Fig.Q5(b)

PART – B

5 a. Find the DTFT of the following signals:
(i) $x(n) = a^{|n|}$; $|a| < 1$ (ii) $x(n) = 2^n u(-n)$ **(08 Marks)**

b. Determine the signal x(n) if its DTFT is as shown in Fig.Q5(b). **(06 Marks)**

c. Compute the Fourier transform of the signal

$$x(t) = \begin{cases} 1 + \cos \pi t & ; \quad |t| \le 1 \\ 0 & ; \quad |t| > 1 \end{cases}$$ **(06 Marks)**

6 a. Find the frequency response of the system described by the impulse response
$h(t) = \delta(t) - 2e^{-2t}u(t)$
and also draw its magnitude and phase spectra. **(08 Marks)**

b. Obtain the Fourier transform representation for the periodic signal
$x(t) = \sin w_0 t$
and draw the magnitude and phase. **(07 Marks)**

c. A signal $x(t) = \cos(20\pi t) + ¼ \cos(30\pi t)$ is sampled with sampling period τ_s. Find the Nyquist rate. **(05 Marks)**

7 a. What is region of convergence (ROC)? Mention its properties. **(06 Marks)**

b. Determine the z-transform and ROC of the sequence $x(n) = r_1^n u(n) + r_2^n u(-n)$. **(07 Marks)**

c. Determine the inverse z-transform of the function, $x(z) = \frac{1 + z^{-1}}{1 - z^{-1} + 0.5z^{-2}}$, using partial fraction expansion. **(07 Marks)**

8 a. An LTI system is described by the equation
$y(n) = x(n) + 0.8\,x(n-1) + 0.8x(n-2) - 0.49y(n-2)$

b. Determine the transfer function H(z) of the system and also sketch the poles and zeros. **(06 Marks)**

c. Determine whether the system described by the equation
$y(n) = x(n) + b\,y(n-1)$ is causal and stable where $|b| < 1$. **(08 Marks)**

Find the unilateral z-transform for the sequence $y(n) = x(n-2)$, where $x(n) = \alpha^n$. **(06 Marks)**

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