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06EC44

Fourth Semester B.E. Degree Examination, June/July 2013
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Distinguish between :
i) Even and odd signals
ii) Periodic and non-periodic signals
iii) Energy and power signals. **(06 Marks)**

b. Sketch the following signals
$x(n) = \delta(n)$
$x(n) = -2u(-n)$
$x(t) = (t-1)\,u(t)$
$x(t) = 2u(t-1) - 2u(t-3)$. **(04 Marks)**

c. For the signal $x(n) = \{1, \underset{\uparrow}{2}, 3, 4\}$, sketch the signal $x(-2n+1)$. **(04 Marks)**

d. Determine whether the system $y(n) = x(n) + 3u(n+1)$ is
i) Linear ii) Time – invariant iii) Causal iv) Memory less v) Stable. **(06 Marks)**

2 a. Derive the expression for convolution sum. **(04 Marks)**

b. Convolve the signals $x_1(n) = 1\delta(n) + 2\delta(n-1) + 3\delta(n-2) + 4\delta(n-3)$ and $x_2(n) = \delta(n) + 2\delta(n-1) + 3\delta(n-2)$. **(06 Marks)**

c. State and prove associative property of convolution integral. **(06 Marks)**

d. Find the response $y(t) = x(t) * h(t)$ for the signal $x(t) = e^{at}\,u(t)$; $a > 0$ and impulse response $h(t) = u(t)$. **(04 Marks)**

3 a. For each of the impulse response listed below, determine whether the corresponding system is i) Causal ii) Memory less iii) Stable. i) $h(t) = e^{-2|t|}$ ii) $h(t) = e^{2|t|}u(t-1)$. **(06 Marks)**

b. Evaluate the forced response of the system
$y'(t) + 2y(t) = e^{-2t}\,u(t)$. **(04 Marks)**

c. Solve the homogeneous difference equation (find natural response)
$y(n) + y(n-1) + \frac{1}{2}y(n-2) = 0$ with $y(-1) = -1$ and $y(-2) = 1$. **(06 Marks)**

d. Draw direct for m – I and direct form – II implementations for the system
$\frac{dy(t)}{dt} + 5y(t) = 3x(t)$. **(04 Marks)**

4 a. State and prove the following properties of Fourier series
i) Time –shift
ii) Frequency –shift. **(06 Marks)**

b. Evaluate the DTFs representation for the signal
$$x(n) = \sin\left(\frac{4\pi}{21}n\right) + \cos\left(\frac{10\pi}{21}n\right) + 1$$
Sketch the magnitude and phase spectra. **(08 Marks)**

c. For the signal $x(t) = \sin w_0 t$, find the Fourier series and draw its magnitude spectrum. **(06 Marks)**

PART – B

5 a. State and prove the following properties of DTFT
   i) Frequency shift
   ii) Frequency differentiation. **(06 Marks)**

b. Find the FT of the following signals
   i) $x(t) = \delta(t)$
   ii) $x(t) = e^{-at} u(t)$; $a > 0$. **(06 Marks)**

c. Find the inverse FT of
$$x(jw) = \frac{jw + 1}{(jw)^2 + 5jw + 6}.$$ **(08 Marks)**

6 a. Find the impulse response of
$$\frac{d^2}{dt^2} y(t) + 3\frac{d}{dt} y(t) + 2y(t) = 2\frac{d}{dt} x(t) + x(t)$$

b. By applying Fourier transform and IFT. **(08 Marks)**
State and prove sampling theorem for low pass signal. **(08 Marks)**

c. Consider the analog signal $x(t) = 3 \cos 50\pi t + 10 \sin 300\pi t - \cos 100\pi t$. What is the Nyquist rate for this signal? **(04 Marks)**

7 a. State and prove :
   i) Linearity
   ii) Differentiation in z – domain, properties of z – transform. **(06 Marks)**

b. Determine the z – transformation of
$x(n) = \{1, 2, \underset{\uparrow}{3}\}$

$x(n) = (2)^n u(n)$
$x(n) = \delta(n + 2)$
$x(n) = -(3)^n u(-n - 1)$. **(08 Marks)**

c. Find out the inverse z – transform of
$$x(z) = \frac{1}{1 - 4z^{-1}}, \text{ RoC : } |z| > |4|.$$
Using power series expansion. **(06 Marks)**

8 a. Find the unilateral z – transform of
$x(n) = \{1, 2, \underset{\uparrow}{3}, 4\}$

$y(n) = a^n u(n + 1)$; $a < 1$. **(06 Marks)**

b. Find the difference – equation description for a system with transform function :
$$H(z) = \frac{y(z)}{x(z)} = \frac{5z + 2}{z^2 + 3z + 2}.$$ **(06 Marks)**

c. Consider the system described the difference question $y(n) - 0.9y(n - 1) = x(n)$. Find output if the input is $x(n) = u(n)$ and the initial condition on the output is $y(-1) = 2$. **(08 Marks)**

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