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10EC44

Fourth Semester B.E. Degree Examination, June/July 2017

Signals and Systems

Time: 3 hrs. Max. Marks:100

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

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.

PART – A

1 a. Discuss the classification of signals with example. **(07 Marks)**

b. Derive an expression to find even and odd components of continuous time signal. **(04 Marks)**

c. For the CTS x(t) shown in Fig.Q1(c), sketch (i) $x(3t + 2)$, (ii) $x(3t) + x(3t + 2)$.

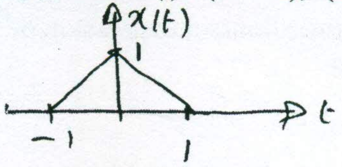

Fig.Q1(c) **(04 Marks)**

d. Determine whether following signals are periodic or not, if periodic find the fundamental period, (i) $x(t) = \{\cos(2\pi t)\}^2$, (ii) $x(n) = \cos 2n$. **(05 Marks)**

2 a. Verify whether the following system is linear, time invariant, memoryless, causal and stable $y(t) = at^2x(t) + bt\,x(t-4)$. **(07 Marks)**

b. Compute the convolution of $x_1(n) = \{\underset{\uparrow}{2}, 3, 4\}$ and $x_2(n) = \{1, 2, \underset{\uparrow}{3}, 4\}$. **(03 Marks)**

c. Compute the convolution of the following : $x(t) = e^{-4t}[u(t) - u(t-2)]$, $h(t) = e^{-2t}u(t)$. **(10 Marks)**

3 a. Find the step response for the LTI system represented by impulse response $h(u) = \left(\frac{1}{4}\right)^n u(n)$. **(03 Marks)**

b. Find the forced response of the system given by $5\frac{dy}{dt} + 10y(t) = 2x(t)$ with $x(t) = 2u(t)$. **(05 Marks)**

c. Find the response of the system described by the difference equation $y(n) - \frac{1}{9}y(n-2) = x(n-1)$ with $y(-1) = 1$, $y(-2) = 0$ and $x(n) = U(n)$. **(07 Marks)**

d. Draw the direct from I and direct form II implementation for $\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} + 5y(t) = \frac{dx(t)}{dt}$. **(05 Marks)**

4 a. Prove the following properties of DTFS:
i) Convolution in time domain
ii) Modulation theorem. **(08 Marks)**

b. Determine the DTFS coefficients of $x(n) = \cos\left(\frac{6\pi}{13}n + \frac{\pi}{6}\right)$. Draw magnitude and phase spectrum. **(06 Marks)**

c. Determine the time domain signal corresponding to the following spectra:

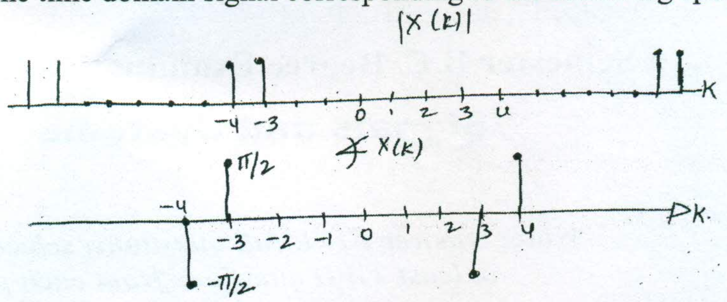

Fig.Q4(c) **(06 Marks)**

PART – B

5 a. Prove time property of discrete time aperiodic sequences. **(03 Marks)**

b. Determine DTFT of $x(n) = a^n u(n)$ and plot magnitude and phase plot. **(05 Marks)**

c. Determine the time domain expression of :

i) $X(e^{j\Omega}) = \dfrac{3 - \frac{1}{4}e^{-j\Omega}}{-\frac{1}{16}e^{-j2\Omega} + 1}$

ii) $X(e^{j\Omega}) = \dfrac{6}{e^{-j2\Omega} - 5e^{-j\Omega} + 6}$

iii) $X(e^{j\Omega}) = \dfrac{6 - \frac{2}{3}e^{-j\Omega} - \frac{1}{6}e^{-j2\Omega}}{-\frac{1}{6}e^{-j2\Omega} + -\frac{1}{6}e^{-j\Omega} + 1}$ **(12 Marks)**

6 a. A causal and LTI system has frequency response, $H[j\omega] = H[\omega] = \dfrac{j\omega + 4}{6 - \omega^2 + 5j\omega}$.

i) Obtain the differential equation for the system.
ii) Determine the impulse response h(t) of s.
iii) What is the output of s if $x(t) = e^{-4t}u(t) - te^{-4t}u(t)$? **(10 Marks)**

b. The input and output of a causal LTI system are related by differential equation:

$$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8y(t) = 2x(t)$$

i) Find h(t).
ii) Find the response of the system for $x(t) = t \cdot e^{-2t}u(t)$. **(10 Marks)**

7 a. Prove the time shifting and differentiation properties of z-transform. **(06 Marks)**

b. Determine the z-transform and ROC of the following sequence $x(n) = -a^n u(-n-1)$. **(04 Marks)**

c. Find the inverse z-transform of $X(z) = \dfrac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$ for (i) $|z| > 1$, (ii) $|z| < 0.5$. **(10 Marks)**

8 a. A causal system has input x(n) and output y(n). Find the impulse response of the system:

$x(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2)$; $y(n) = \delta(n) - \frac{3}{4}\delta(n-1)$ **(10 Marks)**

b. Solve the difference equation for the given initial conditions and input using unilateral z-transform. $y(n) - \frac{1}{9}y(n-2) = x(n-1)$ with $y(-1) = 0$, $y(-2) = 1$ and $x(n) = 3u(n)$. **(10 Marks)**

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