USN | | | | | | | | | | |　　　　**06EC44**

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.***

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. Obtain the even and odd components of the following signals: i) $x(n)=\{1,\underset{\uparrow}{2},3\}$; ii) x(t) as shown in Fig.Q.1(a). **(04 Marks)**

b. Categorize each of the following signals as energy or power signals and find the energy or power of the signal: i) x(t) as shown in Fig.Q.1(b); ii) $x(n)=\left(\frac{1}{3}\right)^n u(n)$. **(06 Marks)**

c. For the signal y(t) shown in Fig.Q.1(c), sketch y(t – 3), y(-t), y(-t + 3) and y(2t + 4). **(05 Marks)**

d. Test the system y(n) = x(n) × x(n) for memory, causality, linearity, stability and time invariance (Note: x(n) is the input). **(05 Marks)**

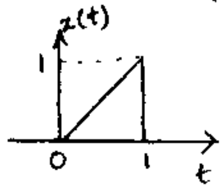

Fig.Q.1(a)

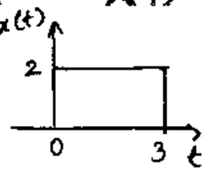

Fig.Q.1(b)

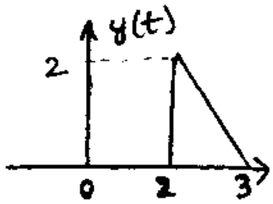

Fig.Q.1(c)

2 a. Evaluate the continuous-time integral y(t) = x(t) * h(t) with $x(t)=e^{-2t}(u(t)-u(t-3))$ and h(t) = 2(u(t + 1) – u(t – 4)). **(12 Marks)**

b. Obtain the discrete-time convolution sum given the impulse response $h[n]=\{1,4,\underset{\uparrow}{3},8\}$ and input $x[n]=\{\underset{\uparrow}{2},5,7\}$. **(08 Marks)**

3 a. Compute the step response of the system with impulse response $h(t)=e^{-3t}u(t)$. **(04 Marks)**

b. Evaluate the natural response of the system described by

$$\frac{d^2y(t)}{dt^2}+\frac{2dy(t)}{dt}+y(t)=\frac{d}{dt}x(t);\ y(0)=1;\ \frac{dy(t)}{dt}\Big/_{t=0}=1.$$ **(08 Marks)**

c. Draw the direct form I and II realization for an LTI system described by the difference equation y(n) + 2y(n – 1) – 3y (n – 3) = x(n) – 2x(n – 2). **(08 Marks)**

4 a. Determine the Fourier series representation for the signal x(t) given by

$x(t)=5\cos\left(\frac{\pi t}{2}+\frac{\pi}{6}\right)$. Sketch the magnitude and phase spectrum. **(06 Marks)**

b. State and prove the time-shift property of the Fourier series. **(05 Marks)**

c. Given the DTFS $x(k)=\{1,\underset{\uparrow}{2},-j,0.5\}$ of a periodic signal x[n] with period N = 7, find x(6) and x(9) using suitable property. **(04 Marks)**

d. Determine x(t) given $w_0=3\pi$ and $x(k)=j\delta(k-1)-j\delta(k+1)+\delta(k-3)+\delta(k+3)$. **(05 Marks)**

PART – B

5 a. Find the Fourier transform of $x(t) = e^{-3t}\,u(t)$. **(05 Marks)**

b. Explain Parsenal's relationship for the Fourier transform. **(04 Marks)**

c. Using inverse Fourier transform, find x(t) whose $x(jw) = \dfrac{-jw}{(jw)^2 + 3jw + 2}$. **(06 Marks)**

d. Compute the DTFT of $x[n] = \left(\dfrac{1}{2}\right)^n u(n)$. **(05 Marks)**

6 a. Obtain the impulse response of the system described by the differential equation $\dfrac{2dy(t)}{dt} + 3y(t) = 7x(t)$ using Fourier transform. **(06 Marks)**

b. Explain the sampling theorem for lowpass signals. **(04 Marks)**

c. Find the Fourier transform of the discrete-time signal x[n]

$$x[n] = \left(\frac{1}{2}\right)^n u(n).$$ **(05 Marks)**

d. Determine the difference-equation description for the system with the frequency response $H(e^{j\Omega}) = \dfrac{1 + e^{-j\Omega}}{3 + e^{-j2\Omega}}$. **(05 Marks)**

7 a. Compute the Z-transform and ROC of the following signals:
i) $x(n) = 2\delta(n+1) + 4\delta(n-2)$; ii) $y(n) = 3^n u(-n)$. **(06 Marks)**

b. State and prove the time-shifting property of the Z-transform. **(05 Marks)**

c. Find the inverse Z-transform of $x(z) = \dfrac{\left(\frac{1}{4}\right)z^{-1}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - \frac{1}{4}z^{-1}\right)}$; ROC $\dfrac{1}{4} < |z| < \dfrac{1}{2}$. **(06 Marks)**

d. Using power series expansion, find (five terms of) x(n) given its $x(z) = \dfrac{z}{2z^2 - 3z + 1}$; $|z| < \dfrac{1}{2}$. **(03 Marks)**

8 a. Given $H(z) = \dfrac{1}{1 - 3z^{-1}}$; ROC : $|z| > 3$. Is the system stable? Causal? Give reasons. **(04 Marks)**

b. Find the difference equation description for a system with transfer function $H(z) = \dfrac{5z + 3}{z^2 + 2z + 4}$. **(05 Marks)**

c. Compute the natural response, forced response and total response of the LTI system with difference equation $y(n) + 3y(n-1) = x(n) + x(n-1)$ if the input is $x(n) = \left(\dfrac{1}{2}\right)^n u(n)$ and $y(-1) = 2$ is the initial condition. **(11 Marks)**

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