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06EC44

Fourth Semester B.E. Degree Examination, June 2012
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting atleast 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. Find the even and odd components of the following signals :

i)

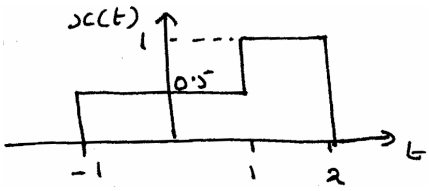

Fig. Q1(a)

ii) $x[n] = [1, 2, \underset{\uparrow}{0}, 1, -2]$. **(04 Marks)**

b. Determine if following signals are energy or power signals :

i) $x(t) = A;\ -T/2 \le t \le T/2$ ii) $x[n] = [1/4]^n u[n]$

$= 0$; elsewhere **(06 Marks)**

c. Given x(t) as shown in Fig. Q1(c), plot x(2t + 2) and x(–t –1). **(04 Marks)**

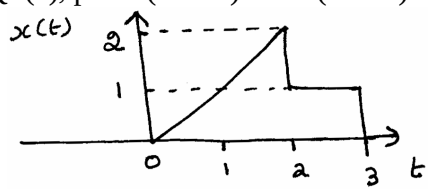

Fig. Q1(c)

d. The input –output relationship in a system is given by y[n] = x[n – 5] + x[n – 7], where x[n] is the input and y[n] the output. Determine the properties of the system. **(06 Marks)**

2 a. Prove that if the impulse response h(t) and the input x(t) are unit step functions the output is a ramp. **(05 Marks)**

b. If h(t) = u(t) – u(t – 3) and x(t) = u(t) = u(t – 1), determine the output y(t). **(08 Marks)**

c. If the input of a discrete LTI system is

$x[n] = [1, \underset{\uparrow}{3}, 2, 2]$ and the impulse response is,

$h[n] = [1, \underset{\uparrow}{4}, 2, 1]$, find the output. **(07 Marks)**

3 a. The output of an LTI system is given by y[n] = x[n + 1] + 2x [n] – x[n – 1]. Find the impulse response if x[n] is the input. Is the system stable? **(04 Marks)**

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

$$\frac{d^2y(t)}{dt^2} + \frac{2dy(t)}{dt} + y(t) = \frac{dx(t)}{dt}; \qquad y(0) = 1; \left.\frac{dy(t)}{dt}\right|_{t=0} = 1.$$ **(06 Marks)**

c. Determine the impulse response of an LTI system described by the difference equation :

y[n] – 0.6y[n – 1] + 0.08y[n – 2] = x[n]. **(06 Marks)**

d. Draw the direct form I and II representations for a system described by the equation :

$$\frac{dy(t)}{dt} + 5y(t) = x(t).$$ **(04 Marks)**

4 a. Find x(t) if the Fourier - Series coefficients are as shown in Fig. Q4(a). The phase spectrum is a null spectrum. **(06 Marks)**

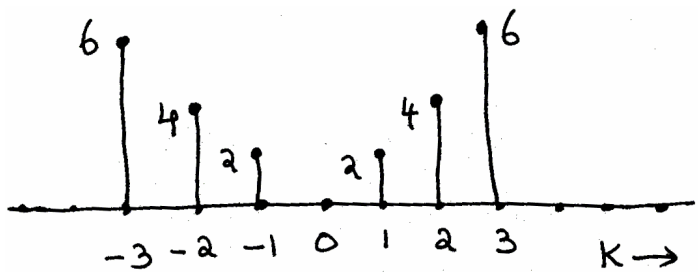

Fig. Q4(a)

b. Determine the Fourier – Series of the signal $x(t) = 3\cos\left(\frac{\pi}{2}t + \frac{\pi}{3}\right)$. Plot the magnitude and phase spectra. **(07Marks)**

c. Show that if x[n] is real and even, its Fourier coefficients are real. Hence find the DTFS coefficients for the signal $x[n] = \sum_{P=-\infty}^{\infty} \delta[n-2p]$. **(07 Marks)**

PART – B

5 a. Find the FT of the sig—function sgn(t) defined by,

$$\text{sgn}(t) = \begin{cases} +1 & t > 0 \\ 0 & t = 0 \\ -1 & t < 0 \end{cases}$$

plot the magnitude and phase spectrum. **(07 Marks)**

b. If the Fourier transform of x(t) is X(jw) then, find the Fourier transform of x(at). **(06 Marks)**

c. Find the DTFT of the signal x[n] = u[n + 2] – u4[n – 3]. **(07 Marks)**

6 a. Find the FT of the train of unit impulses shown in Fig. Q6(a). **(07 Marks)**

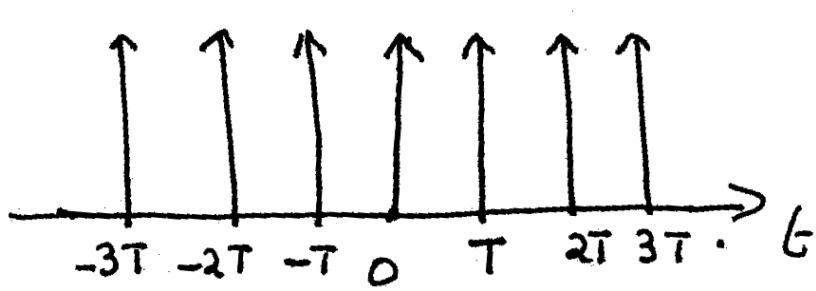

Fig. 6(a)

b. Determine the difference equation description for the system with the impulse response $h[n] = \delta[n] + 2(\frac{1}{2})^n u[n] + (-\frac{1}{2})^n u[n]$. **(06 Marks)**

c. Find the frequency response and impulse response of the system described by the differential equation :

$$2\frac{dy(t)}{dt} + 3y(t) = 7x(t).$$ **(07 Marks)**

7 a. Determine the Z-transform of

$x[n] = -u[-n-1] + (\frac{1}{4})^n u[n]$.

Determine the ROC and pole – zero locations of x(t). **(05 Marks)**

b. If the z-transform of x[n] is X(Z), derive the Z – transform of $a^n x[n]$. **(05 Marks)**

c. Using Z-transform, find the convolution of $x[n] = [\underset{\uparrow}{1},2,-1,0,3]$ and $y[n] = [\underset{\uparrow}{1},2,-1]$. **(05 Marks)**

d. Find the inverse Z – transform of

$$x(z) = \frac{\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}; \text{ROC}: |z| > \tfrac{1}{2}.$$ **(05 Marks)**

8 a. Given the Z –transform of the impulse response h[n] is

$$H(z) = \frac{1}{\left(1-\frac{1}{3}z^{-1}\right)\left(1-\frac{3}{2}z^{-1}\right)}.$$ **(06 Marks)**

What are the possible ROC? Comment on the stability and causality in each case.

b. Determine the transfer function and impulse response of the system described by

$$y[n] - \frac{1}{2}y[n-1] = 2x[n-1].$$ **(07 Marks)**

c. If the impulse response is given by $h[n] = (\frac{1}{3})^n u[n] + (\frac{1}{2})^{n-2} u[n-1]$, find the difference equation of the system. **(07 Marks)**

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