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10EE52

Fifth Semester B.E. Degree Examination, June/July 2014
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain the following properties of the system :
i) Stability ii) Causality iii) Time invariance, with an example. **(06 Marks)**

b. What is the total energy of the rectangular pulse shown in Fig. Q1(b). **(06 Marks)**

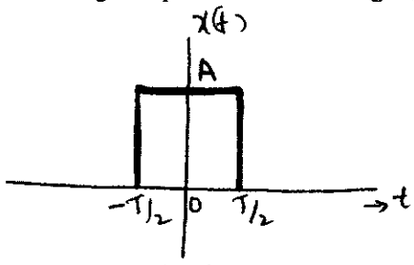

Fig. Q1(b)

c. Let x(t) and y(t) be given in Fig. Q1(c)(i) and Fig. Q1(c)(ii) respectively sketch the following signals. i) x(t) y(t – 1) ii) x(t) y(2 – t). **(08 Marks)**

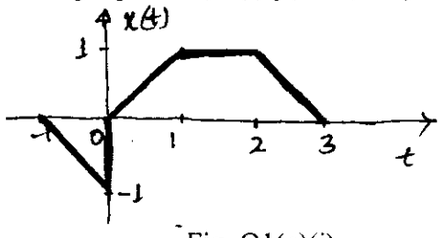

Fig. Q1(c)(i)

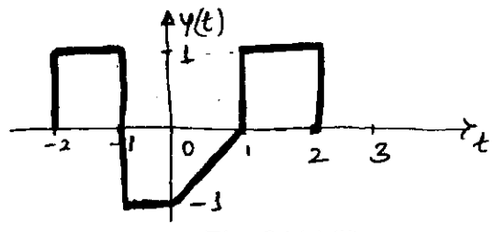

Fig. Q1(c)(ii)

2 a. Prove that for the given LTI system to be stable its impulse response should be absolutely summable. **(05 Marks)**

b. Determine by convolution and sketch response of an LTI system having the unit impulse response

$$h(t) = \begin{cases} \sin t & 0 \le t \le \pi \\ 0 & \text{otherwise} \end{cases}$$ to an input

$$x(t) = \begin{cases} t/\pi & 0 \le t \le \pi \\ 0 & \text{otherwise} \end{cases}$$

Show clearly expression of y(t) for different range. **(10 Marks)**

c. Consider the feedback shown below Fig. Q2(c), where y(n) = 0, n < 0. Sketch y(n) when x(n) = δ(n). **(05 Marks)**

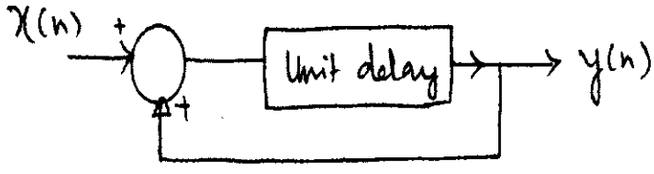

Fig. Q2(c)

3 a. Solve the difference equation :

$y(n) - \frac{1}{4} y(n-1) - \frac{1}{8} y(n-2) = x(n) + x(n-1)$ given $y(-1) = 2$ $y(-2) = -1$ $x(n) = (\frac{1}{2})^n u(n)$. **(08 Marks)**

b. Find the even and odd components of the signal $x(t) = \cos t + \sin t + \sin t \cos t$. **(04 Marks)**

c. Draw the direct form I and direct form II implementation of the following system :

$$\frac{d^3y(t)}{dt^3} + \frac{2d^2y(t)}{dt^2} + 3y(t) = x(t) + \frac{3d^2x(t)}{dt^2}.$$ **(08 Marks)**

4 a. Find the Fourier co-efficient and time signals for the following :

i) $x(n) = \sin\left(\frac{4\pi}{21}\right)^n + \cos\left(\frac{10\pi}{21}\right)^n + 1$

ii) $x(t) = \sin(2\pi t) + \cos(3\pi t)$

iii) $X(k) = \cos\left(\frac{10\pi k}{21}\right) + J\sin\left(\frac{4\pi}{21}k\right)$

iii) $X(k) = J\delta(k-1) - J\delta(k+1) + \delta(k-3) + \delta(k+3)$ with $w_0 = \pi$.

(12 Marks)

b. State and prove following properties :
i) Frequency shift for DTFS
ii) Differentiation and Parseval's for CTFS. **(08 Marks)**

PART – B

5 a. Using defining equations of DTFT and CTFT determine the frequency domain specifications :

i) $x(n) = (\frac{1}{2})^n u(n-4)$ ii) $x(n) = \delta(6-3n)$

ii) $x(t) = e^{-3t} u(t-1)$ iv) $x(t) = e^{-|t|}$. **(10 Marks)**

b. Find the time domain signal for the following :

i) $$x(Jw) = \frac{5Jw + 12}{(Jw)^2 + (5Jw) + 6}$$

ii) $$x(Jw) = \frac{4}{-w^2 + 4Jw + 3}$$

iii) $$x(e^{j\Omega}) = \frac{3 - 5/4e^{-J\Omega}}{1/8e^{-J2\Omega} - 3/4e^{-J\Omega} + 1}$$

iv) $$x(e^{J\Omega}) = \frac{3 - 1/4e^{-J\Omega}}{-1/16e^{-J\Omega} + 1}.$$ **(10 Marks)**

6 a. State and prove low pass sampling theorem. **(08 Marks)**

b. Determine frequency and impulse response for systems described by following differential and difference equation :

i) $\frac{d^2y(t)}{dt^2}+\frac{5dy(t)}{dt}+6y(t)=\frac{-dx(t)}{dt}\; y(0)=-1\;;\frac{dy(0)}{dt}=1$

ii) $y(n)-1/4y(n-1)-1/8y(n-2)=3x(n)-3/4x(n-1)$. **(08 Marks)**

c. An analog signal of band width 'W' Hz is sampled at f_sHz where $f_s > 2W$ for reconstruction one needs low pass filter as shown in Fig. Q6(b), what should be transition band? **(04 Marks)**

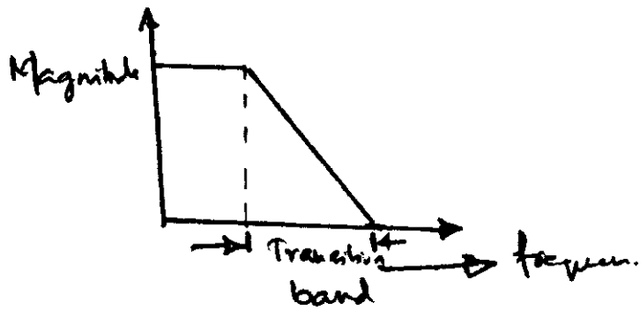

Fig. Q6(c)

7 a. Find Z –transform of following signals and specify its ROC

i) $x(n) = \sin(w_0 n + \theta)\, u(n)$

ii) $x(n) = a^{|n|}$

iii) $x(n)=\begin{cases} a^n & 0 \le n \le N-1 \\ 0 & \text{othwise} \end{cases}$. **(12 Marks)**

b. Using properties find z – transform for the following :

i) $x(n) = n(1/2)^n\, u(n) * (1/2)^n\, u(n)$

ii) $x(n) = n \sin(\pi/2\, n)\, u(-n)$

iii) $x(n) = \sin(\pi/8n - \pi/4)\, u(n-2)$. **(08 Marks)**

8 a. Find inverse Z –transform for the following :

i) $x(z)=\frac{z^3+z^2+3/2z+1/2}{z^3+3/2z^2+1/2z}$

ii) $x(z)=\frac{z}{(z-1)(z-2)^2}$. **(08 Marks)**

b. Given difference equation :

$y(n) - 0.7y(n-1) + 0.12y(n-2) = x(n-1) + x(n-2)$ if $y(-1) = y(-2) = 1$

Find unit simple response, unit step response. **(12 Marks)**

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