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06EC44

Fourth 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. Check whether the following signals are energy or power signals and find the corresponding values.

i) $x_1[n] = u[n]$ ii) $x_2(t) = \begin{cases} A; & -\frac{T}{2} < t < \frac{T}{2} \\ 0; & \text{otherwise} \end{cases}$. **(06 Marks)**

b. Sketch the following signals

$x(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t-3)$

$y[n] = \{1, \underset{\uparrow}{1}, 1, 1, 1, 0.5\} \cdot u[2-n]$. **(06 Marks)**

c. A LTI system 'T' has input and output relation shown in Fig. Q1(c)(i)

i) Determine whether the system is causal and memoryless

ii) Find the output for the input $x_1(t)$ shown in Fig. Q1(c)(ii). **(08 Marks)**

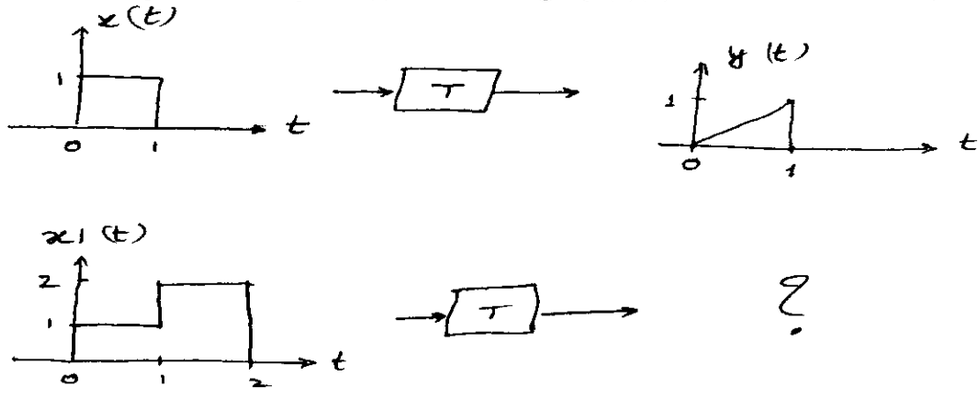

Fig. Q1(b)

2 a. Consider the input signal x[n] and the impulse response h[n] given as :

$x[n] = \begin{cases} 1; & 0 \le n \le 4 \\ 0; & \text{othewise} \end{cases}$ $h[n] = \begin{cases} \alpha^n; & 0 \le n \le 6 \\ 0; & \text{otherwise} \end{cases}$ $\alpha > 1$

b. Compute the output signal y[n]. **(06 Marks)**

For a discrete time LTI system the input and output are related by the equation :

$y[n] = x[n+1] + 5x[n] - 7x[n-1] + 4x[n-2]$

find the impulse response of the system

Also comment on the stability and causality of the system. **(06 Marks)**

c. Find the convolution of $x_1(t)$ and $x_2(t)$ which are given by

$x_1(t) \begin{cases} t; & 0 \le t \le T \\ 0; & \text{otherwise} \end{cases}$ $x_2(t) = \begin{cases} 1; & 0 \le t \le T \\ 0; & \text{otherwise} \end{cases}$

Also plot eth convolved signal. **(08 Marks)**

3 a. By solving difference equation find the impulse response of the system $y[n] + 2y[n-1] + 2y[n-2] = x[n]$. **(06 Marks)**

b. What is the condition the roots of characteristic equation to be satisfied for the system to be stable? Discuss for both continuous and discrete time. **(06 Marks)**

c. Obtain the difference equation for the block diagram, shown in Fig. Q3(c). **(08 Marks)**

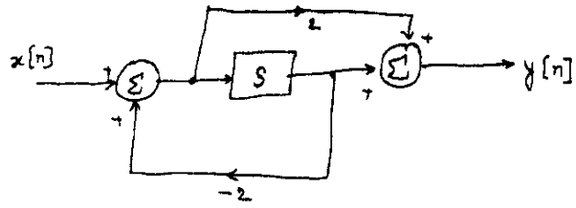

Fig. Q3(c)

4 a. Find the frequency domain representation of the signal shown in Fig. Q4(a). Also plot magnitude and phase spectra. **(06 Marks)**

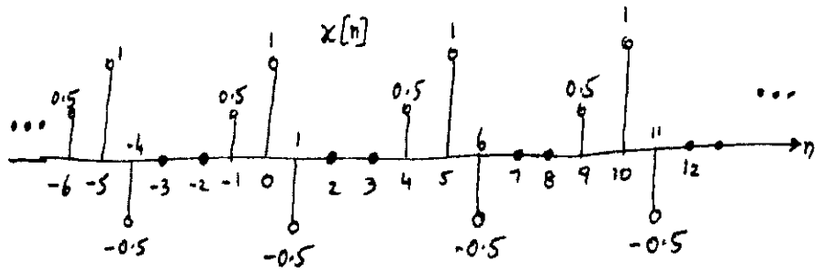

Fig. Q4(a)

b. Determine and sketch the Fourier series for the rectangular pulse train given by

$$x(t) = \begin{cases} A; & -T_s \le t \le T_s; \quad x(t) = x(t+T) \\ 0; & t > |t| \ge T_s \end{cases}$$

Show the amplitude and zero crossing points. **(06 Marks)**

c. State and prove convolution and time shift properties of Fourier transforms. **(08 Marks)**

PART – B

5 a. Find the DTFT of $x[n] = \{1, 3, \underset{\uparrow}{5}, 3, 1\}$ and evaluate $x(e^{j\Omega})$ at $\Omega = 0$. **(06 Marks)**

b. Using partial expansion, determine the inverse Fourier transform of

i) $x(j\omega) = \dfrac{5j\omega + 12}{(j\omega)^2 + 5j\omega + 6}$ ii) $x(j\omega) = \dfrac{-j\omega}{(j\omega)^2 + 3j\omega + 2}$. **(06 Marks)**

c. Determine the Fourier transform of the following :

$x(t) = \delta(t)$ ii) $x(t) = 1$

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

Also plot the magnitude and phase spectra for each of the above. **(08 Marks)**

6 a. State prove sampling theorem. What is aliasing? Explain. **(06 Marks)**

b. Sketch the signals x(t) and v(t) given below and show that, they are orthogonal over the interval (0, 4).

$$x(t) = \begin{cases} 1; & 0 \le t \le 1; \quad 3 \le t \le 4 \\ -1; & 1 \le t \le 3; \end{cases}$$

$$v(t) = \begin{cases} 1; & 0 \le t \le 2 \\ -1; & 2 \le t \le 4 \end{cases}. \quad \textbf{(06 Marks)}$$

c. With eh help of Fourier representation, find the frequency response and the impulse response of the system having eh output y[n] for the input x[n] given below :

$x[n] = (\frac{1}{2})^n u[n]$; $y[n] = \frac{1}{4}(\frac{1}{2})^n u[n] + (\frac{1}{4})^n u[n]$. **(08 Marks)**

7 a. Explain the properties of RoC. **(06 Marks)**

b. Determine all possible signals x[n] associated with Z transform x(z) given as

$$x(z) = \frac{5z^{-1}}{(1-2z^{-1})(1-3z^{-1})}. \quad \textbf{(06 Marks)}$$

c. The system function of a LTI system is given by

$$H(z) = \frac{z^2}{(z-0.2)(z-0.5)(z-2)}$$

Find the impulse response of the system if the system is

i) causal

ii) anticausal

iii) stable

Plot RoC for each case. **(08 Marks)**

8 a. If a discrete time LTI system is BIBO stable, show that the RoC of the system function H(z) must contain the unit circle i.e. $|z| = 1$. **(06 Marks)**

b. A causal discrete time LTI system is described by

$y[n] = x[n] + 3/4y[n-1] - 1/8y[n-2]$

where x[n] and y[n] are the input and output of the system respectively. Find :

i) impulse response h[n] of the system

ii) step response u[n] of the system. **(06 Marks)**

c. A system is described by the difference equation $y[n] = x[n] + 0.5y[n-1]$ find :

i) the transfer function of the system

ii) the output if $x[n] = u[n]$ and $y[-1] = 1$. Use appropriate Z transform. **(08 Marks)**

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