USN

Fourth Semester BE Degree Examination, Dec.09-Jan.10

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Standard notations are used.
3. Missing data be suitably assumed.

PART – A

1 a. Sketch :
 i) $y(t) = r(t+1) - r(t) + r(t-2)$
 ii) $z(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$. **(04 Marks)**

b. i) Is the signal $y(t) = \cos(20\pi t) + \sin(50\pi t)$ periodic? What is the period of y (t)?
 ii) What is the power and energy of the signal, $x(t) = A\cos(wt + \theta)$? **(04 Marks)**

c. Determine the properties of the capacitive system, if the voltage across it $v_c(t) = \frac{1}{c}\int_{-\infty}^{t} i(z)\,dz$, considering i(t) as the input and $v_c(t)$ as output. **(06 Marks)**

d. A discrete time system is given by $y[n] = x[n]\,x[n-1]$. Determine its properties. **(06 Marks)**

2 a. The impulse response is given by $h(t) = u(t)$. Determine the output of the system, if $x(t) = e^{-\alpha t}u(t)$. State any assumptions made. **(06 Marks)**

b. Determine the natural response and forced response of a system described by the relationship: $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = \frac{dx(t)}{dt}$

$$y(0) = 0;\ \frac{dy(t)}{dt}(0) = 1;\ x(t) = e^{-2t}u(t).$$ **(08 Marks)**

c. Obtain the direct form I and II block representation of a system described by the input-output relationship, $\frac{d^2y(t)}{dt^2} + y(t) = 3\frac{dx(t)}{dt}$. **(06 Marks)**

3 a. The impulse response of an LTI system is given by $h[n] = u[n]$. Determine the output if $x[n] = 3^n u[-n]$. **(08 Marks)**

b. If the output of an LTI system is given by: $y[n] = x[n+1] + 2x[n] - x[n-1]$, determine impulse response and comment on the system causality and stability. **(06 Marks)**

c. Determine the step response of a relaxed system whose input output relationship is given by: $y[n] + 4y[n-1] + 4y[n-2] = x[n]$. **(06 Marks)**

4 a. Determine the FS representation of the square wave shown in Fig.4(a). **(07 Marks)**

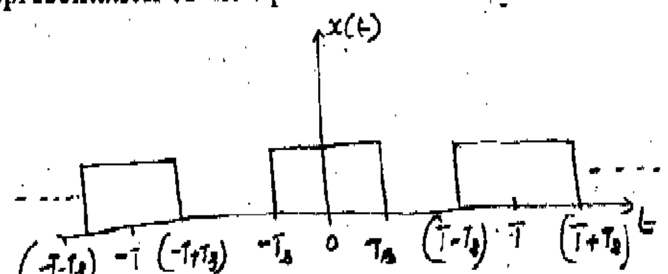


Fig.4(a)

b. If the FS representation of a signal x (t) is x [k], derive the FS of a signal x (t – to) [time shift property of FS]. **(06 Marks)**

c. Determine the DTFS for the sequence $x[n] = \cos^2\left[\frac{\pi}{4}n\right]$. **(07 Marks)**

PART – B

5 a. Show that the Fourier Transform of a rectangular pulse described by:

$$x(t) = 1 \;;\; -T \le t \le T$$
$$= 0 \;;\; |t| > T$$

is a sinc function. Plot the magnitude and phase spectrum. **(07 Marks)**

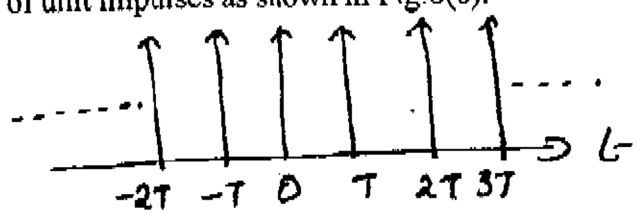
b. If $y(t) = \frac{dx(t)}{dt}$, where x (t) is a non-periodic sigal, find the Fourier Transform of y (t) in terms of x (jw). **(06 Marks)**

c. Determine the DTFT of the signal, $x[n] = \{1, 1, \underset{\uparrow}{1}, 1, 1\}$ and sketch the spectrum $x(e^{j\Omega})$ over the frequency range $-\pi \le \Omega \le \pi$. **(07 Marks)**

6 a. The input $x(t) = e^{-3t}u(t)$ when applied to a system, results in an output $y(t) = e^{-t}u(t)$. Find the frequency response and impulse response of the system. **(07 Marks)**

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

Fig.6(b)



c. Find the FT pair corresponding to the discrete time periodic signal: $x[n] = \cos\left[\frac{2\pi}{N}n\right]$. **(06 Marks)**

7 a. Find the z - transform and RoC of $x[n] = \alpha^{|n|}$. What is the constraint on α? **(06 Marks)**

b. Using properties of z – transform, find convolution of $x[n] = \left[\underset{\uparrow}{1}, 2, -1, 0, 3\right]$ and $y[n] = \left[\underset{\uparrow}{1}, 2, -1\right]$. **(06 Marks)**

c. Determine x [n] if $x(z) = \frac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - 2z^{-1}\right)\left(1 - z^{-1}\right)}$ for i) RoC of $|z| < \frac{1}{2}$ and ii) RoC of $1 < |z| < 2$. **(08 Marks)**

8 a. Find x [n] if $x(z) = \frac{16z^2 - 4z + 1}{8z^2 + 2z - 1}$; RoC : $|z| > 1/2$. **(06 Marks)**

b. Prove the time shift property of unilateral z-transform. **(06 Marks)**

c. Determine the transfer function and difference equation if the impulse response is $h[n] = \left[\frac{1}{3}\right]^n u[n] + \left[\frac{1}{2}\right]^{n-2} u[n-1]$. **(08 Marks)**

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