USN

Fifth Semester B.E. Degree Examination, June-July 2009

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least Two questions from each part.***

PART - A

1 a. For the signal x(t) shown in Fig.1(a), sketch
$y_1(t) = x(10t - 5)$ and
$y_2(t) = x(2t)$

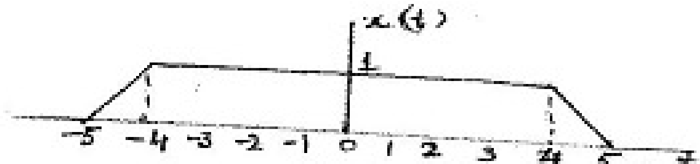

Fig.1(a). **(08 Marks)**

b. Determine whether or not the system $y(n) = x^2(n)$ is i) Linear; ii) Time – invariant. **(08 Marks)**

c. Is the signal $x(n) = \sin(\pi + 0.2n)$ periodic If periodic, find the fundamental period. **(04 Marks)**

2 a. Sketch x(t) h(-t), for the signals shown in fig.2(a). **(06 Marks)**

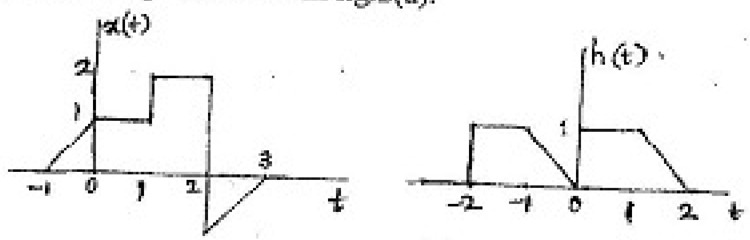

Fig.2(a).

b. Determine convolution of $x_1(t) = e^{-3t} u(t)$ and $x_2(t) = u(t + 2)$. **(08 Marks)**

c. Find the step response of an LTI system if impulse response $h(t) = t^2 u(t)$. **(06 Marks)**

3 a. Draw direct form I and II structures for the system described by the differential equation
$$\frac{d^3y(t)}{dt^3} + \frac{2dy(t)}{dt} + 3y(t) = x(t) + \frac{3dx(t)}{dt}$$
(06 Marks)

b. Determine the natural response, forced response, and total response of the system described by difference equation.
$y(n) + uy(n-1) + uy(n-2) = 2^n u(n)$
with $y(-1) = 0$ $y(-2) = 1$ **(08 Marks)**

c. A discrete time system has unit impulse response $h(n) = \frac{1}{2} f(n) + f(n-1) + \frac{1}{2} f(n-2)$
Find i) Frequency response.

ii) Steady state response to input $x(n) = 5\cos\frac{\pi}{4}n$. **(06 Marks)**

4 a. State and prove time-shift property as applied to Fourier series. **(06 Marks)**

b. Determine complex Fourier coefficients for the signal x (t) as shown in Fig.4(b). Plot its amplitude spectrum and phase spectrum. **(08 Marks)**

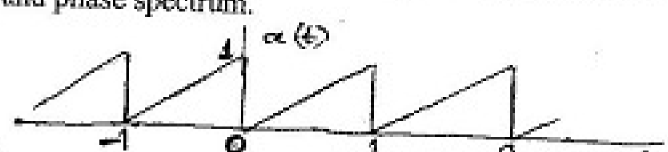

Fig.4(b).

c. State and prove Parseval's theorem, in case of Discrete Time Fourier Series (DTFS).

(06 Marks)

PART - B

5 a. Sketch the sequence $x(n) = \sum_{m=-\infty}^{\infty} f(n-4m)$. Find Fourier coefficients and plot the spectrum.

(08 Marks)

b. Find the inverse Fourier Transform of $x(w) = \dfrac{jw+12}{(jw)^2 + 5jw + 6}$.

(08 Marks)

c. State and prove frequency shift property of Discrete Time Fourier Transform (DTFT).

(04 Marks)

6 a. Find the inverse DTFT of $X(e^{j\Omega}) = \dfrac{3 - \frac{1}{4}e^{-j\Omega}}{-\frac{1}{16}e^{-j2\Omega} + 1}$.

(08 Marks)

b. A discrete time LTI system is described by y (n) + ½ y (n-1) = x (n). Determine

i) Frequency response $H(e^{j\Omega})$.

ii) Impulse response of the system, h (n).

iii) Response y (n) to an input x (n) having Fourier transform $X(e^{j\Omega}) = \dfrac{1 + \frac{1}{2}e^{-j\Omega}}{1 - \frac{1}{4}e^{-j\Omega}}$.

(12 Marks)

7 a. Find Z transform and sketch ROC of

i) $x(n) = -u(-n-1) + (1/2)^n u(n)$

ii) $x(n) = na^{n-1} u(n)$.

(10 Marks)

b. Find inverse Z transform of

$$X(z) = \frac{z^2}{z^2 - 1.5z + 0.5}$$

for Roc of i) $|z| > 1$

ii) $|z| < 0.5$

iii) $0.5 < |z| < 1$.

(10 Marks)

8 a. Determine the response of the system described by the difference equation y (n) = 5/6 y(n-1) −1/6 y(n-2) + x(n) to the input x(n) = f (n) −1/3 f (n-1) using Z transform and inverse transform.

(10 Marks)

b. A linear LTI system is characterized by the system function $H(z) = \dfrac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$

Specify ROC of H(z) and determine h(n) for i) System is stable; ii) Causal; iii) Anticausal.

(10 Marks)