NEW SCHEME

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Third Semester B.E. Degree Examination, July/August 2005

EC / TE / ML / IT / BM / EE

Signals and Systems

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Make any suitable assumptions for missing data.
3. Indicate the question number and subdivisions clearly.

1. (a) For each of the systems, state whether the system is linear, shift-invariant, stable, causal, invertible :

i) $y(n) = log(x \mid n \mid)$ ii) $y(n) = x(n^3)$ (5+5 Marks)

(b) Determine whether or not the following signals are periodic. FInd the period, if they are periodic

i) $x(t) = v(t) + v(-t)$ where $v(t) = sin(t)\, u(t)$

ii) $cos\left[\frac{1}{5}\pi n\right] \quad sin\left[\frac{1}{3}\pi n\right]$

(c) Given $x(n) = \{0, 0, 0, \underset{\uparrow}{1}, 2, 3, 2, 1, 0, 0, 0\}$, plot $x[-2-1], x\left[\frac{n}{2}\right]$ (2+2 Marks)

2. (a) Fig Q.2(a) shows parts of the signal $x(t)$ and its even part for $1 \geq 0$ only. $x(t)$ and even part for $t < 0$ is not shown. Complete the plots of $x(t)$ and $x_e(t)$. Also obtain the odd part of $x(t)$.

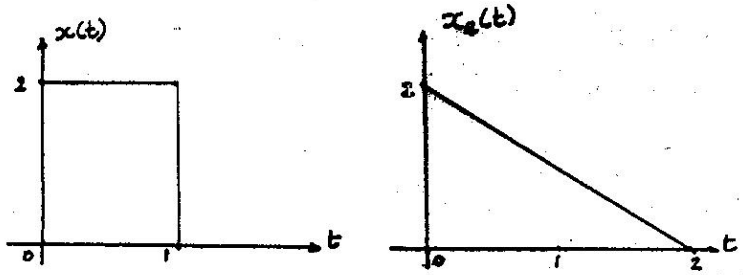

Fig. Q 2(a)

(b) Determine the energy or power as applicable for the following signals.

i) $e^{j\left(\frac{\pi}{2}n + \frac{\pi}{6}\right)}$

ii) $\left[\frac{1}{3}\right]^n u(n)$ (2+2 Marks)

(c) Determine graphically, the output of an LTI system whose impulse response is $h(t) = 3u(t-1) - 3u(t-3)$ and input is $x(t) = u(t+1) - 2u(t-1) + u(t-3)$ (8 Marks)

Contd.... 2

3. (a) Determine the convolution of two given sequences $x(n) = \{1, \underset{\uparrow}{2}, 3, 4\}$ and $h(n) = \{\underset{\uparrow}{1}, 1, 3, 2\}$ **(6 Marks)**

(b) There LT1 systems are interconnected as shown in Fig Q3(b). If $h_1(n) = u(n-2)$, $h_2(n) = nu(n)$ and $h_3(n) = \delta(n-2)$, find the overall impulse response.

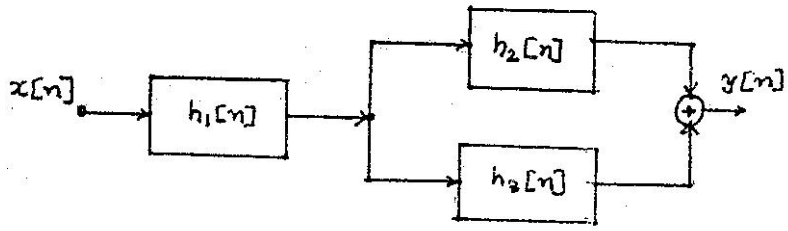

Fig. Q3(b)

(6 Marks)

(c) The differential equation of the system is given as

$\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = x(t)$, with $y(0) = 3, \frac{dy}{dt}|_{t=0} = -5$. Determine the total response of the system for a step input. **(8 Marks)**

4. (a) Draw the direct form II block diagram of the system given by the difference equation $y(n) - 0.25y(n-1) - 0.125y(n-2) - x(n) - x(n-2) = 0$. How many delay elements, adders and multipliers are used ? **(3+3 Marks)**

(b) A discrete time signal is defined by $x(n) = sin[\pi n/8]$. Sketch the magnitude and phase of the Discrete Time Fourier Transform of $x(n-2)$. **(8 Marks)**

(c) Using the Parseval's theorem find the signal energy of

i) $x(t) = 4sinc(t/5)$

ii) $x(t) = 2sinc^2(3t)$ **(3+3 Marks)**

5. (a) Obtain the Continuous Time Fourier Transform (CTFT) of

$$x(t) = \begin{cases} \frac{1}{2}[1 - |t|] & -1 < 1 < 1 \\ 0 & elsewhere \end{cases}$$

using the integral property of CTFE. Also indicate the CTFT of $x(t-1) - \frac{1}{2}$ **(5+3 Marks)**

(b) A periodic signal with a period of 4sec is described over one fundamental period by $x(t) = 3 - t$, $0 < 1 < 4$. Plot the signal and find the exponential Fourier series. Plot the amplitude and phase spectrum. Obtain the average value of $x(t)$. **(2+6+2+2 Marks)**

Contd.... 3

6. (a) Obtain the impuse response of the network shown in Fig Q6.a). Determine the frequency response $H(j\omega)$ of the network. Determine the frequency at which $|H(j\omega)|$ falls to $1/\sqrt{2}$. Find the corresponding phase.

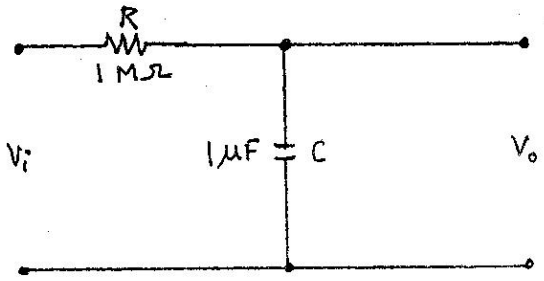

Fig Q 6(a)

(3+6+3 Marks)

(b) FInd the Nyquist rate for each of the following signals :

i) $x(t) = 25e^{j500\pi t}$

ii) $x(t) = [1 + 0.1sin(200\pi t)]\, cos(2000\pi t)$

iii) $10sinc(5t)$

iv) $2sinc(50t)\ sin(5000\pi t)$ (2+2+2+2 Marks)

7. (a) The spectrum $X(j\omega)$ of a signal as shown in fig Q 7(a). Draw the spectrum of the sampled signal at i) twice the Nyquist rate and ii) half the Nyquist rate. Mark the frequency values clearly in the figure.

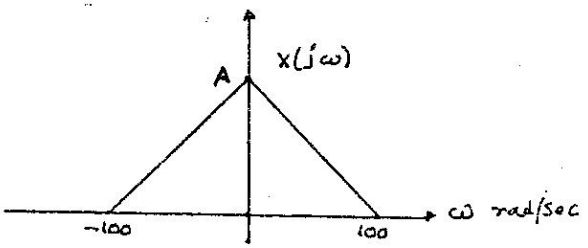

Fig. Q7(a)

(3+3 Marks)

(b) Find the Z-transform and also given ROC

i) $x(n) = 2^n u(n) + 3^n u(-n-1)$

ii) $e^{\frac{-n}{10}}\ sin\left[\frac{2\pi n}{8}\right]\ u(n)$ (3+3 Marks)

(c) Obtain the complete response of the system given in linear difference equation form using Z - transform. Assume the system to have zero initial conditions.

$$y(n) + y(n-1) - 2y(n-2) = u(n-1) + 2u(n-2)$$ (8 Marks)

8. (a) The signal $x(t) = e^{-at}$ is sampled every T sec beginning at $t = 0$. Find the Z-transform of the sampled signal. Give two different values of (a, T) such that Z - transforms of the sampled signals are same. **(6+2 Marks)**

(b) A causal system has $4H(z) = \frac{8}{z^{-2}-6z^{-1}+8}$. Determine the pole locations is the system stable ? Obtain the impulse response $h(n)$. What will be impulse response of the system. If the system is known to be anti-causal ? **(2+2+6+2 Marks)**

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