USN

Fifth Semester B.E. Degree Examination, May/June 2010
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. Distinguish between:
i) Continuous and discrete time signals. ii) Even and odd signals.
iii) Periodic and non-periodic signals. iv) Energy and power signals. **(08 Marks)**

b. Determine whether the following signals are periodic, if periodic determine the fundamental period.
i) $x(t) = \cos 2t + \sin 3t$ ii) $x(n) = \cos\left(\frac{1}{5}\pi n\right)\sin\left(\frac{1}{3}\pi n\right)$ **(06 Marks)**

c. Find the energy for the following signals:
i) $x(t) = \begin{cases} A & 0 \le t \le T \\ 0 & \text{elsewhere} \end{cases}$ ii) $x(n) = \left(\frac{1}{3}\right)^n u(n)$ **(06 Marks)**

2 a. For the system, $y(n) = \log(x(n))$, state wheter the system is linear, shift-invariant, stable, causal and invertible. **(05 Marks)**

b. Find $z(t) = x(2t).y(2t+1)$, where x(t) and y(t) are given as below: **(06 Marks)**

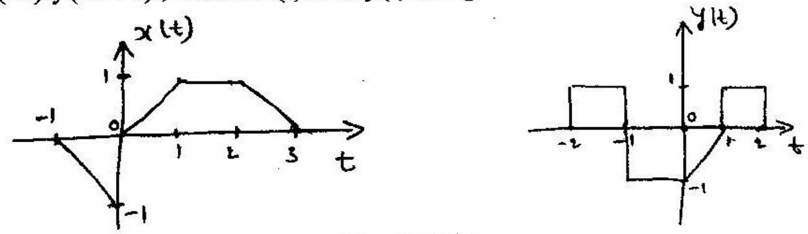

Fig. Q2 (b)

c. Obtain the convolution of the given two signals. Also sketch the result signal.
Given : $h(t) = \begin{cases} 1 & \text{for } 1 < t < 3 \\ 0 & \text{otherwise} \end{cases}$, $x(t) = \begin{cases} (1-t) & \text{for } 0 \le t \le 1 \\ 0 & \text{otherwise} \end{cases}$. **(09 Marks)**

3 a. Find the total response of the system described by the equation, $4y(n) + 4y(n+1) + y(n+2) = x(n)$ with an input $x(n) = 4^n u(n)$. Initial conditions being $y(-1) = 0$, $y(-2) = 1$. **(08 Marks)**

b. Draw the direct form I and direct form II implementation of the following system:
$$4\frac{d^3y(t)}{dt^3} - 3\frac{dy(t)}{dt} + y(t) = x(t) + \frac{dx(t)}{dt}$$ **(06 Marks)**

c. The impulse response of a LTI system is, $h(t) = e^{2t}u(t-1)$. Check whether the system is stable, causal and memory less. **(06 Marks)**

4 a. Obtain the DTFS representation for the signal shown, $x(n) = \sin\left(\frac{4\pi}{21}n\right) + \cos\left(\frac{10\pi}{21}n\right) + 1$ sketch the magnitude and phase spectra. **(10 Marks)**

b. Prove the following properties:
i) Convolution property of periodic discrete time sequences.
ii) Parseval's relationship for the Fourier series. **(10 Marks)**

PART – B

5 a. State and prove the following properties of DTFT:
i) Time shifting property and ii) Time differentiation property. **(06 Marks)**

b. Determine the frequency domain representations for the following signals:

i) $x(t) = e^{-3t}u(t-1)$ ii) $x(n) = \left(\frac{1}{2}\right)^n u(n-4)$ **(06 Marks)**

c. Determine the time domain expression for the following:

i) $x(j\omega) = \dfrac{2j\omega + 1}{(j\omega + 2)^2}$ ii) $x(e^{j\Omega}) = \dfrac{6 - \frac{2}{3}e^{-j\Omega} - \frac{1}{6}e^{-j2\Omega}}{-\frac{1}{6}e^{-j2\Omega} + \frac{1}{6}e^{-j\Omega} + 1}$ **(08 Marks)**

6 a. An LTI system is given by,

$$H(f) = \frac{4}{2 + 2\pi f}$$

Find its response y(t) if the input x(t) = u(t). **(08 Marks)**

b. Obtain the impulse response of the network shown in figure Q6 (b). Determine the frequency response $H(j\omega)$ of the network. Determine the frequency at which $|H(j\omega)|$ falls to $\frac{1}{\sqrt{2}}$. Find corresponding phase. **(12 Marks)**

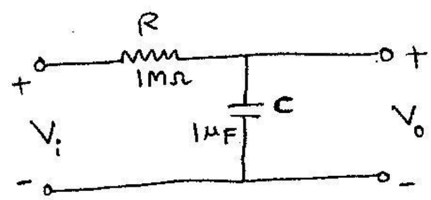

Fig. Q6 (b)

7 a. Prove the following properties of z-transformation:
i) Differentiation in z-domain. ii) Time reversal property. **(08 Marks)**

b. Find the z-transformation of the following signals:

i) $x(n) = n\left(\frac{1}{3}\right)^{n+3} u(n+3)$ ii) $x(n) = n\left(\frac{1}{2}\right)^n u(n) * \left[\delta(n) + \frac{1}{2}\delta(n-1)\right]$ **(12 Marks)**

8 a. Consider the system described by the difference equation,

$$y(n) - 2y(n-1) + 2y(n-2) = x(n) + \frac{1}{2}x(n-1)$$

Find system function H(z) ad unit step response h(n) of the system. Also find the stability of the system. **(10 Marks)**

b. A causal system has input x(n) and output y(n). Use the transfer function to determine the impulse response of the system.

$$x(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2)$$

$$y(n) = \delta(n) - \frac{3}{4}\delta(n-1)$$ **(06 Marks)**

c. Find the impulse response of the causal system, $y(n) - y(n-1) = x(n) + x(n-1)$ **(04 Marks)**

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