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**Fourth Semester B.E. Degree Examination, December 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) Periodic and non-periodic signals and ii) Deterministic and random signals. (04 Marks)
- b. A signal  $x(t)$  is as shown in figure Q1 (b). Find its even and odd parts. (06 Marks)

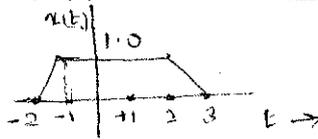


Fig. Q1 (b)

- c. Two signals  $x(t)$  and  $g(t)$  are as shown in figure Q1 (c). Express the signals  $x(t)$  in terms of  $g(t)$ . (06 Marks)

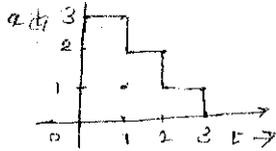


Fig. Q1 (c) - (i)



Fig. Q1 (c) - (ii)

- d. A system is described by  $y(n) = (n+1)x(n)$ . Test the system for (i) memory less (ii) Causality (iii) Linearity (iv) Time invariance and (v) Stability. (04 Marks)
- 2 a. An LTI system has impulse response  $h(n) = [U(n) - U(n-4)]$ . Find the output of the system if the input  $x(n) = [U(n+10) - 2U(n+5) + U(n-6)]$ . Sketch the output. (08 Marks)
  - b. Show that an arbitrary signal  $x(n)$  can be expressed as a sum of weighted and time shifted impulses,  $x(n) = \sum_{k=-\infty}^{\infty} x(k)\delta(n-k)$ . (04 Marks)
  - c. An LTI system is described by an impulse response  $h(t) = [U(t-1) - U(t-2)]$ . Find the output of the system if the input  $x(t)$  is as shown in figure Q2 (c). Sketch the output. (08 Marks)

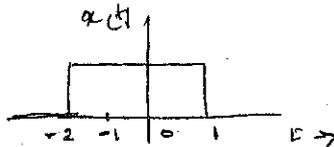


Fig. Q2 (c)

- 3 a. Two LTI systems with impulse responses  $h_1(n)$  and  $h_2(n)$  are connected in cascade. Derive the expression for the impulse response if the two systems are replaced by a single system. (04 Marks)
- b. An LTI system has its impulse response,  $h(n) = 4^{-n} U(2-n)$ . Determine whether the system is memory less, stable and causal. (04 Marks)
- c. A system is described by a differential equation,  $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t) + \frac{dx(t)}{dt}$ . Determine its forced response if the input  $x(t) = [\cos t + \sin t]U(t)$  (06 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

3 d. Draw the direct form I and direct form II implementations for the following difference equation,  $y(n] + \frac{1}{2}y(n-1) - y(n-3) = 3x(n-1) + 2x(n-2)$ . (06 Marks)

4 a. State and prove convolution property of continuous time Fourier series. (06 Marks)  
 b. Find the DTFS co-efficients of the signal shown in figure-Q4 (b), (08 Marks)

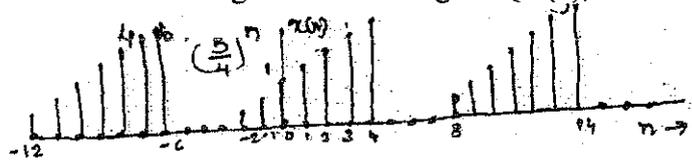


Fig. Q4 (b)

c. Determine the time domain signal  $x(t)$ , whose Fourier co-efficient are,  
 $X(K) = \frac{3}{2}e^{-j\frac{\pi}{4}K}$ ,  $K = -1$ ;  $X(K) = \frac{3}{2}e^{j\frac{\pi}{4}K}$ ,  $K = 1$ ;  $X(K) = 0$  otherwise. (06 Marks)

**PART - B**

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

b. Show that the Fourier transform of a train of impulses of unit height separated by T secs is also a train of impulses of height  $\omega_0 = \frac{2\pi}{T}$  separated by  $\omega_0 = \frac{2\pi}{T}$  sec. (08 Marks)

c. Find the DTFT of following signals and draw its magnitude spectrum:  
 i)  $x(n) = a^n U(n)$ ;  $|a| < 1$  ii)  $x(n) = \delta(n)$  unit impulse. (06 Marks)

6 a. The system produces an output  $y(t) = e^{-t}u(t)$  for an input of  $x(t) = e^{-2t}u(t)$ . Determine the frequency response and impulse response of the system. (08 Marks)

b. State and prove sampling theorem for low pass signals. (07 Marks)

c. Find the Nyquist rate for the following signals:  
 i)  $x(t) = 25e^{j500\pi t}$  ii)  $[x(t)] = [1 + 0.1 \sin(200\pi t)] \cos(2000\pi t)$  (05 Marks)

7 a. State and prove time reversal and differentiation in Z-domain properties of Z-transforms. (06 Marks)

b. Find the Z-transforms of following sequences including R.O.C.: i)  $x(n) = -\left(\frac{1}{2}\right)^n u(-n-1)$

ii)  $x(n) = \alpha^{|n|}$   $|\alpha| < 1$  (06 Marks)

c. The Z-transform of sequence  $x(n)$  is given by,  $X(z) = \frac{z(z^2 - 4z + 5)}{(z-3)(z-2)(z-1)}$

Find  $x(n)$  for the following ROC's:

i)  $2 < |z| < 3$  ii)  $|z| > 3$  iii)  $|z| < 1$ . (08 Marks)

8 a. Solve the following linear constant co-efficient difference equation using z-transform method:  $y(n] - \frac{3}{2}y(n-1) + \frac{1}{2}y(n-2) = \left(\frac{1}{4}\right)^n u(n)$  with initial conditions,  $y(-1) = 4$ ,  $y(-2) = 10$ . (10 Marks)

b. A causal system has input  $x(n]$  and output  $y(n]$ . Find the impulse response of the system if,  
 $x(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2)$ ;  $y(n) = \delta(n) - \frac{3}{4}\delta(n-1)$

Find the output of the system if the input is  $\left(\frac{1}{2}\right)^n u(n)$ . (10 Marks)

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