USN | | | | | | | | | | **06EC44**

Fourth Semester B.E. Degree Examination, December 2012

Signals and Systems

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Make valid assumptions for any missing data.***

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.

PART – A

1 a. Write the formal definition of a signal and a system. With suitable examples, state the important differences between:
i) Continuous and discrete sinusoid ii) Even and odd symmetry waveforms **(10 Marks)**

b. Illustrate how the stability of an LTI system can be computed in time domain. **(02 Marks)**

c. The impulse response of an LTI system may be represented by

$$h[n] = \begin{cases} a^n & n \geq 0 \\ b^n & n < 0 \end{cases}.$$

Determine the range of values of a and b so that the given system is stable. **(08 Marks)**

2 a. State and prove the following properties of convolution sum:
i) Commutative property ii) Associative property iii) Distributive property **(10 Marks)**

b. Find the convolution of two infinite duration sequences $x[n] = \alpha^n u[n]$, $h[n] = \beta^n u[n]$ when i) $\alpha > \beta$, ii) $\alpha = \beta$, iii) $\alpha < \beta$. **(10 Marks)**

3 a. Determine the total response y[n], $n \geq 0$ of a system described by the following difference equation using time domain method:

$$y[n] - 3y[n-1] - 4y[n-2] = x[n] + 2x[n-1]$$

Assume $x[n] = 4^n u[n]$ and zero initial conditions. **(10 Marks)**

b. Obtain direct Form – II representation for the following differential equation representation

$$2\frac{d^3}{dt^3}y(t) + 4\frac{d}{dt}y(t) + 6y(t) = 2x(t) + 6\frac{d}{dt}x(t)$$ **(05 Marks)**

c. Obtain the difference equation representation for the following realized system shown in Fig.Q3(c). **(05 Marks)**

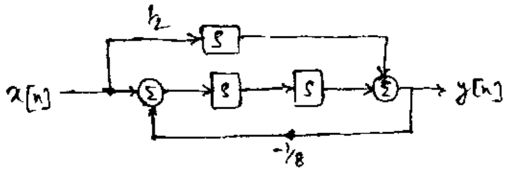


Fig.Q3(c)

4 a. Evaluate the discrete time Fourier series (DTFS) representation of x[n] and plot magnitude and phase spectrum when $x[n] = \cos\left(\frac{6\pi}{17}n + \frac{\pi}{3}\right)$. **(06 Marks)**

b. Determine the time domain signal x[n] when its discrete time Fourier coefficient specified as

$$X[K] = \cos\left(\frac{10\pi}{19}K\right) + j\,2\sin\left(\frac{4\pi}{19}K\right)$$ **(06 Marks)**

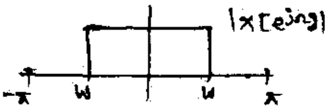
c. Determine the complex exponential Fourier series representation for the following continuous time signal x(t) where x(t) = cos 4t + sin 6t. Plot its spectrum. **(08 Marks)**

PART – B

5 a. Find the discrete time Fourier transformation of the time domain sequence $x[n] = \alpha^n u[n]$ and plot the magnitude and phase spectrum for the values of α (i) $\alpha = 0.5$, (ii) $\alpha = 0.9$. **(08 Marks)**

b. The DTFT of a time domain sequence is defined as

$$X(e^{j\Omega}) = \begin{cases} 1 & |\Omega| < W \\ 0 & W \le |\Omega| < \pi \end{cases}$$



Find its IDTFT and plot x[n]. **(06 Marks)**

c. For a moving average spectrum is described by $y[n] = \frac{1}{2}[x[n] + x[n-1]]$. Find its frequency response $H(e^{j\Omega})$ and plot amplitude and spectrum. **(06 Marks)**

6 a. The input to a discrete time system is given by $x[n] = \cos\left(\frac{\pi}{8}n\right) + \sin\left(\frac{3\pi}{4}n\right)$. Use the DTFT to find the output of the system y[n], if the impulse response is given by

i) $h[n] = \frac{\sin(\pi/4\, n)}{\pi n}$ ii) $h[n] = (-1)^n \frac{\sin(\pi/2\, n)}{\pi n}$ **(10 Marks)**

b. Consider the continuous time domain analog signal given by $x(t) = 3\cos 100\pi t$.

i) Determine the minimum sampling rate required to avoid aliasing.

ii) Suppose the signal is sampled at F_s = 200 Hz, find the corresponding discrete time sequence.

iii) Suppose the signal is sampled at F_s = 75 Hz, find the corresponding discrete time sequence

iv) What is the frequency $0 < F < \frac{F_s}{2}$ of a sinusoid that yields samples identical to those obtained in part (iii)? **(10 Marks)**

7 a. Define z-transformation and its inverse. State the important condition for the existence of the z transformation using ROC. **(05 Marks)**

b. Explain how the ROC in the z domain can change if the corresponding time domain sequences can be left sided, right sided and two sided, while the length can be of finite or infinite duration. **(05 Marks)**

c. Give that $x[n] = \begin{cases} a^n & \text{for } 0 \le n \le N-1 \\ 0 & \text{otherwise} \end{cases}$. Let a = 0.5, N = 8. Find z{x[n]} using:

i) Direct evaluation of finite sum of X [z], ii) Sample shifting property of X [z].
Plot its poles and zeros, ROC, and comment on stability. **(10 Marks)**

8 a. A causal LTI system is characterized by having input sequence $x[n] = \left(-\frac{1}{3}\right)^n u[n]$ and output sequence $y[n] = 3(-1)^n u[n] + \left(\frac{1}{3}\right)^n u[n]$. Determine its transfer function impulse response and difference equation representation. **(10 Marks)**

b. Solve the following difference equation using unilateral z transforms and find time domain solution:

i) $y[n+2] - 3y[n+1] + 2y[n] = 4^n u[n]$ for y[0] = 0, y[1] = 1.

ii) $y[n] + y[n-2] = \delta[n]$ zero initial conditions. **(10 Marks)**

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