Question Paper

Exam Date & Time: 06-Jun-2018 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
IV SEMESTER B.S. DEGREE MAKE-UP EXAMINATION-MAY/JUNE 2018
DATE: 6 JUNE 2018
TIME: 9.30 AM TO 12.30 PM
Signal Processing [EC 244A]

Marks: 100 **Duration: 180 mins.**

Answer ANY FIVE full Questions.
Missing data, if any, may be suitably assumed.

1) (10)

A) Let x[n] and y[n] be given in Fig1a and Fig1b respectively. Carefully sketch the following signal.

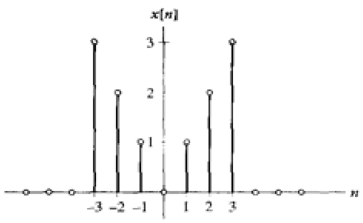

Fig1a

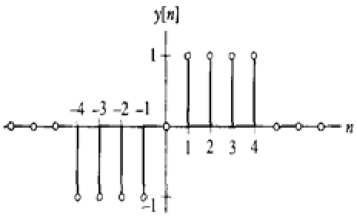

Fig1b

i. x[3n-1]
ii. y[2-2n]

B) (10)

Determine the frequency response and the impulse response of the discrete LTI system described by the following difference equation.

$$y[n]-\frac{1}{4}y[n-1]-\frac{1}{8}y[n-2=x[n]-\frac{1}{3}x[n-1].$$

Determine the output of this system for the input,

$$x[n]=\delta[n]-\left(\frac{1}{4}\right)\ \delta[n-1]$$

2) (10)

A) Consider a discrete LTI system having an impulse response $h[n]=\left(\frac{3}{4}\right)^n u[n]$.

Compute the response of the system for the input $x[n]=u[n+2]-u[n-11]$ using convolution.

B) (10)

Draw the DF-1 and DF-II structures for an LTI system represented by the following differential/difference equation.

i. $y[n]+1.2y[n-1]-\frac{1}{8}y[n-2]=2x[n]+x[n-1]$

ii. $3y(t)+6\frac{dy(t)}{dt}+\frac{d^3y(t)}{dt^3}=2x(t)+3\frac{dx(t)}{dt}$

3) (10)

A)

Use the method of partial fraction to obtain the time- domain signal corresponding to the following z-transform

$$X(z) = \frac{1 + \frac{7}{6} z^{-1}}{\left(1 - \frac{1}{2} z^{-1}\right)\left(1 + \frac{1}{3} z^{-1}\right)} \quad \text{ROC} |z| > \frac{1}{2}$$

B) Use the table of transform and properties to find the inverse DTFT of the following signal (10)

i. $X(e^{j\Omega}) = j\sin(4\Omega) - 2$

ii. $X(e^{j\Omega}) = \begin{cases} e^{-j4\Omega} & \frac{\pi}{4} < |\Omega| < \frac{3\pi}{4} \ for |\Omega| < \pi \\ 0 & otherwise \end{cases}$

4) (10)

A) Determine the frequency response and the impulse response of the system having the output y[n] and input x[n] as given below,

$$x[n] = \left(\frac{1}{2}\right)^n u[n], y[n] = \frac{1}{4}\left(\frac{1}{2}\right)^n u[n] + \left(\frac{1}{4}\right)^n u[n]$$

B) Draw the frequency response of the following ideal digital filters (10)

i. Low-pass

ii. High – pass

iii. Band - pass

5) (10)

A) Compare IIR and FIR filters.

B) State and prove the following z-transform properties (10)

i. Time reversal

ii. Convolution

iii. Differentiation in the z-domain

6) (10)

A) Determine the inverse DTFT of the following.

$$X(e^{j\Omega}) = \frac{-\frac{5}{6}e^{-j\Omega} + 5}{1 + \frac{1}{6}e^{-j\Omega} - \frac{1}{6}e^{-2j\Omega}}$$

B) Use the table of transform and properties to find the FT of the following signal (10)

i. $x(t) = \sin(2\pi t)e^{-t}u(t)$

ii. $x(t) = \left(\frac{\sin(t)}{\pi t}\right) * \frac{d}{dt}\left[\left(\frac{\sin(2t)}{\pi t}\right)\right]$

7) (10)

A)

An LTI system has impulse response $h(t) = 2\cos(6\pi t)\frac{\sin(\pi t)}{\pi t}$. Using Fourier transform, determine the output if the input is $x(t) = 5 + \sin(\pi t) + \cos(6\pi t)$.

B) Find the Nyquist rate and Nyquist interval for the following signals, (10)

i. $m(t) = \frac{1}{2\pi}\cos(4000\pi t)\cos(1000\pi t)$

ii. $m(t) = \frac{\sin(500\pi t)}{\pi t}$

8) (10)

A) Use the table of transform and properties to find the inverse FT of the following

i. $X(j\omega) = \frac{j\omega}{(1 + j\omega)^2}$

ii. $X(j\omega) = \frac{1}{j\omega(j\omega + 2)} - \pi\delta(\omega)$

B) Calculate the 8 point DFT of sequence x[n] = {1 1 1 1 0 0 0 0}. (10)

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