Question Paper

Exam Date & Time: 01-Dec-2018 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
IV SEMESTER B.S. ENGG. END SEMESTER EXAMINATION - NOV./ DEC. 2018
Signal Processing [EC 244A]

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

Answer 5 out of 8 questions.

1) Using suitable properties of Fourier representation obtain the Fourier representation of the following. (10)

A)

$$x(t) = \frac{1}{1+t^2} \qquad \text{b. } x[n] = \sin\left(\frac{\pi}{4}n - \frac{\pi}{4}\right)\left(\frac{1}{4}\right)^n u[n-1]$$

B) Determine whether or not following systems are linear, time in-variant, causal and stable. (10)

1. $y(t) = \frac{dx(t)}{dt}$
2. $y[n] = 2x[n]u[n]$
3. $y(t) = x(2-t)$

2) Let input to the LTI system with impulse response $h[n] = \alpha^n\{u[n-2] - u[n-13]\}$ be (10)

A) $x[n] = 2\{u[n+2] - u[n-12]\}$. Compute the output y[n] using convolution.

B) State and prove the following properties for the Fourier transform representation. (10)

i) Time and Frequency shifting
ii) Convolution and Modulation

3) Use the properties of Fourier to find the FT of the following signals (10)

A)

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

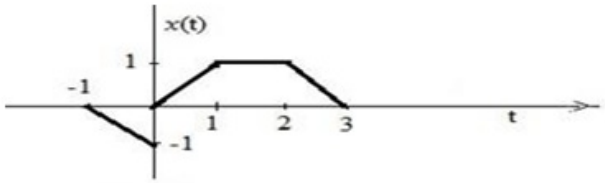
ii. $x(t) = \left(\frac{\sin(t)}{\pi t}\right) * \frac{d}{dt}\left[\left(\frac{\sin(2t)}{\pi t}\right)\right]$

B) Evaluate DTFS coefficient for the signal (10)

$$x[n] = \sin\left(\frac{4\pi}{21}n\right) + \cos\left(\frac{10\pi}{21}n\right) + 2$$

4) Find and plot the even and odd component of x(t) as shown in Fig4. (10)

A)



B) For each of the following impulse responses, determine whether the corresponding system is i) memory less ii) causal and stable (10)

1. $h(t) = \cos(\pi t)u(t)$
2. $h[n] = \cos\left(\frac{\pi}{8}n\right)\{u[n] - u[n-10]\}$

5) Sketch the waveform for the following signals (10)

A) i. $x(t) = r(t+1) - r(t) + r(t-2)$

ii. $x(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t-3)$

Where r(t) is the unit ramp and u(t) is the unit step function.

B) Draw the frequency response of the following ideal digital filters (10)
i) Low-pass
ii) High - pass
iii) Band - pass

6) Evaluate the step response for the following LTI systems (10)

A) i. $h[n] = \delta[n] - \delta[n-2]$

ii. $h(t) = \frac{1}{4}\left[u(t) - u(t-4)\right]$

B) (10)

A LTI system is described. $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2\frac{dx(t)}{dt} + x(t).$ Determine
i) Frequency response
ii) Impulse response of the system
iii) Output of the system for the input $x(t) = e^{-3t}u(t)$

7) Draw the DF-I and DF-II structures for an LTI system represented by the following differential/difference equations. (10)

A)

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

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

B) Compare IIR and FIR filters. (10)

8) Consider the LTI system described by the difference equation (10)

A) $7y[n-1] - y[n-2] - 12y[n] = 12x[n].$

Determine the system function and the impulse response. Obtain the pole zero plot and hence comment on the stability and causality of the system.

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

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