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Paper Code : OE-601A/OE-EE601A Digital Signal Processing

UPID : 006623

Time Allotted : 3 Hours *Full Marks :70*

The Figures in the margin indicate full marks.

Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following : [1 x 10 = 10]

(I) Autocorrelation function of periodic signal is equal to _______ of the signal.

(II) The function given by the equation x(n)=1, for n=0; x(n)=0, for n≠0 is called ------------- function.

(III) Write down the differentiation property of z transform

(IV) The Fourier transform of $x(n)=(0.8)^n$ is --------------------- , where n=0,1,2,3..

(V) Infinite memory system is also known as ---------------- system.

(VI) Power spectrum describes distribution of _________ under frequency domain.

(VII) The filter that may not be realized by approximation of derivatives techniques are called -----------

(VIII) Explain the non-parametric methods of power spectrum estimation.

(IX) Show whether the function is periodic or not

$$x(t) = \cos\left(\frac{2}{5}\pi t\right) + \cos\left(\frac{2}{7}\pi t\right)$$

(X) Z and Laplace transform are related by……………………….

(XI) By applying time shifting property determine the z transform of the

$$x(z) = \frac{z^{-1}}{1-3z^{-1}}$$

(XII) Write the formula of IDFT.

Group-B (Short Answer Type Question)

Answer any three of the following : [5 x 3 = 15]

2. Write down the energy and power equation in continuous and discrete domain. [5]
3. Find the inverse z transform of [5]

$$G(z) = \frac{0.78z}{(z-0.60)(z-1)}$$

4. Explain the power spectrum estimation using AR model. [5]
5. Consider the following two LTI systems: H1(z) = 1 + 0.5z^-1 + 0.25z^-2 H2(z) = 1 - 0.9z^-1 + 0.81z^-2 Determine the impulse response of the system H(z) = H1(z) * H2(z) using convolution in time domain. [5]
6. A lowpass Butterworth filter is designed with a passband edge frequency of 2 kHz and a stopband edge frequency of 2.5 kHz. The sampling rate is 8 kHz, and the passband and stopband ripple are both 0.1 dB. Determine the filter order and the filter coefficients. [5]

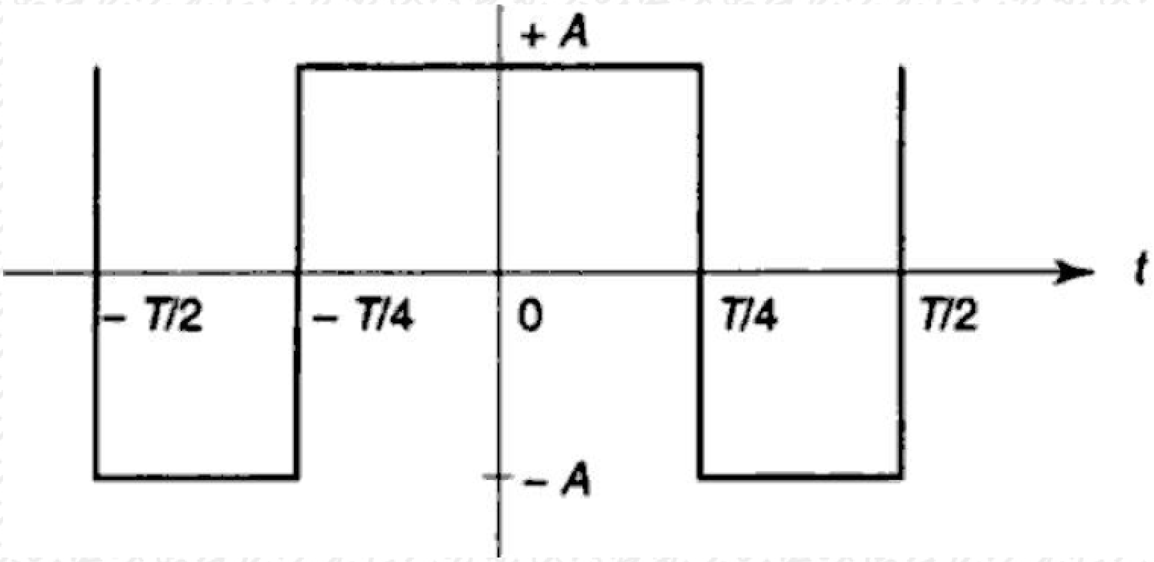
Group-C (Long Answer Type Question)

Answer any three of the following : [15 x 3 = 45]

7. a)Compute the autocorrelation and power spectral density for the signal [7+8]
$x(t)=K\cos(2\pi f_c t+\phi)$
Where K and fc are constant and ϕ is a random variable which is uniformly distributed over the interval (-π,π)
b)Determine the estimation of the autocorrelation and power spectrum of random signals.
8. a)Explain the following methods of IIR filter design [7+4+4]
impulse invariant method
approximation of derivative methods

b)use the backward difference for the derivative and convert the analog filter with system function
H(s)=1/(s^2+16)
c)For the analog transfer function
H(s)=1/(s+1)(s+2)
Determine H(z) using impulse invariant method

9. a) Compute the signal energy and power for the system given below [6+3+6]
i) x(t)=e^(-4t) u(t)
u(t)=1 for t ≥0
u(t)=0 for t<0
ii)x(t)=e^(-3|t|)
b) Define unit pulse function and write down its mathematical formula
c) Find the Fourier coefficient and Fourier series of the signal given below



10. a)Explain the Decimation of Time (DIT) algorithms of FFT [8+7]
b) With help of DIT FFT method find the DFT of the sequence given below
x(n)={ 1,2,3,4,4,3,2,1}

11. a)Explain the different methods of calculation of inverse z transform. [4+8+3]
b)Find the inverse z transform of the function given below
i)Use long division method

$$F(z) = \frac{z+1}{z^2+0.2z+0.1}$$

ii)Use partial fraction method

$$F(z) = \frac{z+1}{z^2+0.3z+0.02}$$

c)Determine the relationship between z transform and DFT

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