Printed Pages : 2 **Roll No.** | | | | | | | | | | | **EEN011**

B. TECH.

THEORY EXAMINATION (SEM–VI) 2016-17

FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING

Time : 3 Hours ***Max. Marks : 100***

Note : *Be precise in your answer. In case of numerical problem assume data wherever not provided.*

SECTION-A

1 **Attempt the following :** **(10×2=20)**

a) State properties of ROC

b) Show whether $x(t) = \{A; 0<t<T_0 \text{ and } 0; \text{otherwise}\}$ is an energy signal or power.

c) Determine and sketch the even and odd components of the continuous time signal $x(n) = e^{-n/4} u(n)$.

d) Define a continuous time signal and show that the product of two odd signals is an even signal.

e) What is zero padding? What are its uses?

f) How twiddle factor is defined. Find its value for N=4.

g) Explain frequency warping effect. How this problem is overcome in bilinear transformation technique of IIR filter design?

h) State sampling theorem.

i) Draw frequency response of Band Pass Filter and Band Stop Filter.

j) What do you understand by input quantization error?

SECTION-B

2 **Attempt any five of the following :** **(10×5=50)**

a) Given that $x(n) = (1, 2, 3, 2, 1)$ and that x (n) ---------- X (e^{jw}), determine the following without calculating X (e^{jw}).

(i) $X(e^{j0})$ **(ii)** $\angle X(e^{j\omega})$ **(iii)** $X(e^{j\pi})$

(iv) $\int_{-\pi}^{\pi} X(e^{j\omega})\, d\omega$ **(v)** $\int_{-\pi}^{\pi} |X(e^{j\omega})|^2\, d\omega$

b) For the DT system described by the difference equation $y(n)=0.6y(n-1)-0.08y(n-2)+x(n)$, determine

i) The unit-sample response sequence h(n), ii) Whether it is BIBO Stable?

c) If $x(n) = a^{|n|}; 0<a<1$, find the DTFT of x (n) and plot its magnitude spectrum. Find the Fourier transform of Signuum function

d) The impulse response of the LTI system is $h(t) = u(t)$. Determine the output of the system by graphical convolution method (or convolution integral method) if input $x(t) = e^{-at} u(t); a>0$.

e) Find DFT of the given sequence using DIT FFT algorithm and DIF FFT algorithm, and hence verify your answer

$x(n)=\{1,2,3,4,4,3,2,1\}$

f) What is the method of estimates of the autocorrelation sequences to perform spectrum analysis of random signals?

g) Derive the mathematical expression for impulse invariance technique. Discuss its disadvantages and how it can be taken care of.

h) Discuss overlap add and overlap save method for linear filtering of infinite data sequence.

SECTION-C

Attempt any two of the following : **(15×2=30)**

3 Write short notes on

(i) Over sampling and noise shaping in A/D convertors.

(ii) Effect of coefficient quantization.

(iii) Discrete Cosine Transform.

4 (i) Discuss in details the frequency response of a rational system function.

(ii) Design a low pass FIR filter for the following specification:

Cutoff frequency=500Hz

Sampling frequency=2000Hz

Order of filter, N=10

Length of filter, M=11

Use Hamming window to get modified impulse response.

5 Consider the analog signal

$$x_a(t) = 3cos100\pi t$$

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

(ii) Suppose that the signal is sampled at the rate of Fs = 200 Hz, what is the discrete-time signal obtained after sampling?

(iii) Suppose that the signal is sampled at the rate of Fs = 75 Hz, what is the discrete-time signal obtained after sampling?

(iv) What is the frequency of a sinusoid that yields samples identical to those obtained in part (iii)?