

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)**

- State properties of ROC
- Show whether $x(t) = \{A; 0 < t < T_0 \text{ and } 0; \text{otherwise}\}$ is an energy signal or power.
- Determine and sketch the even and odd components of the continuous time signal $x(n) = e^{-n/4} u(n)$.
- Define a continuous time signal and show that the product of two odd signals is an even signal.
- What is zero padding? What are its uses?
- How twiddle factor is defined. Find its value for $N=4$.
- Explain frequency warping effect. How this problem is overcome in bilinear transformation technique of IIR filter design?
- State sampling theorem.
- Draw frequency response of Band Pass Filter and Band Stop Filter.
- What do you understand by input quantization error?

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

- Given that $x(n) = (1, 2, 3, 2, 1)$ and that $x(n) \longleftrightarrow X(e^{j\omega})$, determine the following without calculating $X(e^{j\omega})$.
 - $X(e^{j0})$
 - $\angle X(e^{j\omega})$
 - $X(e^{j\pi})$
 - $\int_{-\pi}^{\pi} X(e^{j\omega}) d\omega$
 - $\int_{-\pi}^{\pi} |X(e^{j\omega})|^2 d\omega$
- For the DT system described by the difference equation $y(n) = 0.6y(n-1) - 0.08y(n-2) + x(n)$, determine
 - The unit-sample response sequence $h(n)$,
 - Whether it is BIBO Stable?
- If $x(n) = a^{n/2}$; $0 < a < 1$, find the DTFT of $x(n)$ and plot its magnitude spectrum. Find the Fourier transform of Signum function
- 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 $x(t) = e^{-at} u(t)$; $a > 0$.
- Find DFT of the given sequence using DIT FFT algorithm and DIF FFT algorithm, and hence verify your answer
 $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$
- What is the method of estimates of the autocorrelation sequences to perform spectrum analysis of random signals?
- Derive the mathematical expression for impulse invariance technique. Discuss its disadvantages and how it can be taken care of.
- 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
- $$x_a(t) = 3\cos 100\pi t$$
- (i) Determine the minimum sampling rate required to avoid aliasing
 - (ii) Suppose that the signal is sampled at the rate of $F_s = 200$ Hz, what is the discrete-time signal obtained after sampling?
 - (iii) Suppose that the signal is sampled at the rate of $F_s = 75$ 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)?