**SIDDHARTH INSTITUTE OF ENGINEERING AND TECHNOLOGY :: PUTTUR**
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**QUESTION BANK**

**Subject with Code : ADVANCED DIGITAL SIGNAL PROCESSING(16EC3802)**

**Course & Branch**: M.Tech – ( DECS) **Year & Sem:** I-M.Tech & I-Sem

# UNIT –I

## OVERVIEW OF SIGNALS AND SYSTEMS

1. (a) What are the types of discrete time signals? [5M]
   (b) Explain the sequence representations of sequences. [5M]
2. (a) Explain the types of discrete time systems with example. [5M]
   (b) Explain simple low-pass FIR digital filters and high-pass FIR digital filters. [5M]
3. (a) State LTI discrete time systems. [3M]
   (b) Explain the classification of LTI discrete time systems with examples. [7M]
4. (a) Check whether the following systems are LTI or not:
   (i). $Y(n)=2x(n+2)-x(n-2)$ [4M]
   (ii) $Y(n)=n^2x(2n)$ [4M]
   (b) What is linear time invariant system? [2M]
5. (a) What is convolution? State and prove convolution theorem of two signals using Continuous time Fourier transforms. [6M]
   (b) What is the difference between DFT and CFT? [4M]
6. (a) Give the expression for DFT pair. [3M]
   (b) Explain the energy spectrum of a discrete time sequence. [7M]
7. What is the relationship between impulse response of LTI-DTS and its frequency response? Prove the relationship using convolution summation. [10M]
8. (a) Define an LTI System and show that the output of an LTI system is given by the Convolution of Input sequence and impulse response. [5M]
   (b) Give the expressions for types of linear phase transfer function. [5M]
9. (a) Prove that the system defined by the following difference equation is an LTI System. Given $y(n) = x(n+1)-3x(n)+x(n-1)$ ; $n\geq0$. [5M]
   (b) Explain the inverse discrete time systems. [5M]
10. (a) Define DFT and IDFT. State any four properties of DFT. [5M]
    (b) Find 8-Point DFT of the given time domain sequence $x(n) = \{1, 2, 3, 4\}$. [5M]

# UNIT –II

## DIGITAL FILTER STRUCTURE AND DESIGN

1. (a) Express the realization of a digital sine-cosine generator. [5M]

   (b) Discuss about the computational complexity of digital filter structures [5M]

2. (a) Explain the interpolation process with an example. [7M]

   (b) Explain the need for multirate signal processing. [3M]

3. Explain the Pade's approximation method for designing IIR filter. [10M]

4. (a) Develop a minimum-multiplier realization of a length-9 type 3 FIR transfer function. [5M]

   (b) Realize the following transfer functions in Gray-Markel form and comment on BIBO Stability. $H(z) = \frac{2+Z^{-1}+2Z^{-2}}{1-0.75Z^{-1}+(1/8)Z^{-2}}$. [5M]

5. (a) Explain the computational complexity of Digital filter structures. [5M]

   (b) Explain the single multiplier sine-cosine generator with diagram. [5M]

6. (a) Explain the realization of all pole IIR transfer function. [5M]

   (b) Explain the Gray-Markel method of realization of IIR transfer function. [5M]

7. (a) Explain the realization of arbitrary FIR transfer function. [5M]

   (b) Realize the $4^{th}$ order FIR transfer function using cascaded lattice structure. [5M]

   $H_4(z) = 1 + 1.2Z^{-1} + 1.12Z^{-2} + 0.12Z^{-3} - 0.08Z^{-4}$.

8. (a) Explain the realization of power - symmetric FIR cascaded lattice structure. [5M]

   (b) Realize the $4^{th}$ order FIR transfer function using power - symmetric FIR cascaded lattice Structure . $H_4(z) = 1 + 0.3Z^{-1} + 0.2Z^{-2} + 0.376Z^{-3} - 0.06Z^{-4} + 0.2Z^{-5}$ [5M]

9. Explain the computationally efficient FIR digital filters

   (a) Interpolated FIR filter [5M]

   (b) Frequency response masking approach. [5M]

10. (a) Explain the state space structure of Digital filters. [5M]

    (b) Explain the poly-phase structure of Digital filters. [5M]

# UNIT –III

## FFT ALGORITHEMS

1. (a) Define Multi-rate systems and Sampling rate conversion. [5M]

   (b) Discuss the process of n Decimation by a factor D and explain how the aliasing effect can be eliminated. [5M]

2. (a) Explain the interpolation process with an example. [5M]

   (b) Explain the need for multi-rate signal processing. [5M]

3. Explain with necessary equations and block diagram, the implementation of the chirp-z transform for computing the DFT. [10M]

4. (a) Explain the decimation process with an example. [5M]

   (b) What is the need for interpolation and decimation? [5M]

5. (a) Explain Goertzel algorithm for the computation of DFT. [5M]

   (b) Derive the flow graph of the decimation in frequency FFT algorithm for N = 8. [5M]

6. (a) Explain the time-domain and frequency domain analysis of sampling rate conversion by a factor of I/D. [5M]

   (b) Perform the two-band poly-phase decomposition of the transfer function: $H(z) = \frac{2+Z^{-1}}{1+0.75Z^{-1}}$. [5M]

7. (a) Give the frequency domain analysis of Decimator. [5M]

   (b) Explain how to implement Multirate filter using poly phase decomposition. [5M]

8. With the help of block diagram explain the sampling rate conversion by a rational Factor ‘I/D’. Obtain necessary expressions. [10M]

9. (a) Explain the split – radix FFT. [5M]

   (b) Compare the FFT algorithms. [5M]

10. (a) Explain the Cooley-Tukey FFT algorithm for FFT computation. [5M]

    (b) Explain the prime factor algorithm for FFT computation. [5M]

# UNIT –IV

## POWER SPECTRAL ESTIMATION

1. (a) Suppose we have N = 1000 samples from a sample sequence of a random process. Determine the frequency resolution of the Bareltt, Welch (50% overlap) methods for a quality factor Q = 10. [7M]
   (b) How the parametric methods are overcome the limitations of non-parametric methods? [3M]
2. (a) Describe MA method for Power Spectrum Estimation with relevant Expressions. [5M]
   (b) Analyze and discuss Non Parametric Estimation of Power spectrum using ARMA model. [5M]
3. (a) Derive the Yule walker equation for spectral estimation. [6M]
   (b) Compare parametric and non-parametric methods of spectral estimation. [4M]
4. (a) Explain Bartlett method of power spectrum estimation. [5M]
   (b) Derive an expression for AIC of ARMA model for power spectrum estimation. [5M]
5. (a) Discuss any one of the non-parametric methods for power spectrum estimation [5M]
   (b) For the AR process of the order two x(n)= a1 x(n-1) + a2 x(n-2) w(n). [5M]
   Where a1 and a2 are constants w(n) is a white noise process of zero mean and variance .
   Calculate the mean and autocorrelation of x(n).
6. (a) Explain clearly the Barlett method of implementation for power spectral estimation and Compare it Blackman-Tukey procedure. [6M]
   (b) Compare various non-parametric methods of power spectrum estimation with respect to Figure of merit, quality, variability, resolution and number of computations. [4M]
7. (a) Discuss the method of power spectrum estimation using Blackman-Tukey method. [4M]
   (b) Bring out the relationship between the parameters of AR, MA and ARMA models of Power spectrum estimation and autocorrelation matrix of input data [6M]
8. (a) Explain Power spectrum estimation by Weltch method. [5M]
   (b) Design and explain Power Spectrum Estimation by Burg Method. [5M]
9. (a) Discuss about computation of Energy density spectrum [5M]
   (b) ) write short notes on periodogram. [5M]
10. (a) Explain the relation between autocorrelation and model parameters. [5M]
    (b) Explain the use of DFT in power spectrum estimation. [5M]

# UNIT-V

## ANALYSIS OF FINITE WORDLENGTH EFFECTS IN FIXED-POINT DSP SYSTEMS

1. (a) Explain the methods to represent numbers for digital computation. [5M]
   (b) Explain in detail, the finite word length effects in IIR digital filter. [5M]
2. (a) Explain the applications of DSP in oversampling sigma-delta D/A convertor. [5M]
   (b) Explain some of the special audio effects that are implemented in digital for musical sound processing. [5M]
3. (a) Show that the standard deviation is proportional to the length of the FIR filter due to quantization of coefficients. [5M]
   (b) Derive the expression for signal to noise ratio of a first order IIR low pass filter. [5M]
4. (a) Explain Oversampling D/A converter. [5M]
   (b) Explain DTMF. [5M]
5. (a) Explain Spectral analysis of sinusoidal signals. [5M]
   (b) The system difference equation is y(n) = 0.5 y(n-1) – 0.6 y(n-2) + 2x(n). Calculate quantization step, variance of the error signal and variance of the Quantization noise at the output for a input signal in the range 10 V. [5M]
6. (a) Briefly discuss about the musical sound processing by DSP. [5M]
   (b) Explain in detail about the oversampling process in A/D converter. [5M]
7. (a) Compare fixed and floating type of processors. [5M]
   (b) Discuss about the finite word length effects in computation of FFT algorithms. [5M]
8. (a) ) Define spectrum and hence discuss the importance of spectral analysis. [4M]
   (b) Explain in detail about the over sampling process in D/A converter. [6M]
9. (a) Explain clearly about quantization in ADC and the effect of it on data length. Relate length to noise power spectral density. [5M]
   (b) Explain Spectral analysis of non-sinusoidal signals. [5M]
10. (a) Explain discrete time analytic signal generation. [6M]
    (b) Briefly explain STFT. [4M]

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