Roll No. | | | | | | | | | | | | | **Total No. of Pages : 02**

Total No. of Questions : 08

M.Tech.(EPDT) (2016 & Onwards) (Sem.–2)

ADVANCED DIGITAL SIGNAL PROCESSING

Subject Code : MTET-203

M.Code : 74400

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

INSTRUCTIONS TO CANDIDATES :

1. **Attempt any FIVE questions in all.**
2. **Each question carries TWENTY marks.**

1. a) Explain raidx-2 decimation in frequency (DIF) algorithm for calculating fast Fourier transform (FFT) 10

   b) Find the convolution of the signal $x_1(n)$ with the signal $x_2(n)$ using convolution property of Z-transform. The signals $x_1(n)$ and $x_2(n)$ are defined as : 5

$$x_1(n) = a^n u[n],\ x_2(n) = u[n]$$

   c) Find the N-point DFT of the sequence 5

$$x\,(n) = 4 + \cos^2\left(\frac{2\pi n}{N}\right)\ n = 0,\ 1,\ \ldots..\ N-1$$

2. a) Explain the procedure of IIR filter desing using Impulse Invariance method with an example. Compare IIR and FIR filters. 10

   b) Use the window design method to design a linear phase FIR filter of order N = 24 to approximate the following ideal frequency response magnitude. 10

$$|H_d(e^{j\omega})| = \begin{cases} 1 & |\omega| \le 0.2\pi \\ 0 & 0.2\pi < |\omega| \le \pi \end{cases}$$

   Give your design for both rectangular and hamming window.

3. a) With the help of proper mathematical expression, explain how the energy density spectrum is related to Fourier transform of the signal and the autocorrelation function of the finite energy signal? 10

   b) Give the various steps involved in the parametric estimation process. Discuss various parametric power spectrum estimation methods and compare their performance with non-parametric methods. 10

4. a) Explain backward linear prediction method for linearly predicting the value of a stationary random process. Also explain the orthogonality property of the backward prediction errors. 12

   b) Consider a signal $x(n) = s(n) + w(n)$, where $s(n)$ is an AR (1) process that satisfies the difference equation. 8

$$s(n) = 0.6\, s(n-1) + v(n)$$

   Where, $\{v(n)\}$ is a white noise sequence with variance $\sigma_v^2 = 0.64$ and $\{w(n)\}$ is a white noise sequence with variance $\sigma_w^2 = 1$. Design a Wiener filter of length M = 2 to estimate $\{s(n)\}$

5. a) Explain minimum phase property of forward prediction error filter and maximum phase property of the backward prediction error filter. 10

   b) Explain FIR Wiener filters for filtering and prediction. 10

6. a) What is the need of Multirate digitial signal processing (MDSP)? Explain the interpolation process for an integer factor I with an example. 10

   b) Describe the sampling rate conversion by a rational factor (I/D). Discuss filter design and implementation for sampling rate conversion. 10

7. a) Write a short notes on the following two application of Multirate signal processing 10

      i) Analysis and Synthesis Filter banks

      ii) Transmultiplexer

   b) Why the AR model is widely used in power spectrum estimation? Describe auto regressive (AR) and moving average (MA) models used in power spectrum estimation. 10

8. What is the difference fixed point and floating point processor? Explain the architecture, addressing modes and interrupts of ADSP21xx processor. Compare ADSP21xx processor with TMS320Cxx. 20

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.