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# B.M.S. College of Engineering, Bengaluru-560019

**Autonomous Institute Affiliated to VTU**

## February / March 2023 Semester End Main Examinations

**Programme: B.E.** **Semester: V**
**Branch: ES Cluster (EI/MD/EC/EE/ET)** **Duration: 3 hrs.**
**Course Code: 19ES5CCDSP** **Max Marks: 100**
**Course**: **Digital Signal Processing** **Date: 27.02.2023**

**Instructions**: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.





### UNIT - I

1 a) Consider the analog signal, $x_a(t)=3\cos(2000\pi t)+5\sin(6000\pi t)+10\cos(12000\pi t)$. **06**

i) What is the Nyquist rate?

ii) If Fs=5000 samples/sec, Write the discrete time signal

iii) What is the analog signal $y_a(t)$ that can be reconstructed from the samples if ideal interpolation is used?

b) Compute the energy in frequency domain using Parseval's theorem for the 6-point sequence x[n]={1,3,-2,1,-3,4}. **06**

c) Apply DFT-IDFT method to compute the circular convolution of two given sequences x[n]={2,1,2,1}, h(n)= {1,2,3,4}. **08**

**OR**

2 a) Compute 4-point DFT of x(n)={1,-2,2,-1}.Write 4-point DFT of y(n)={-2,2,-1,1} using properties of DFT. **06**

b) Compute the circular correlation of the sequence x(n)={1,1,2,1}. **06**

c) Given 10-point sequence x(n)={1,2,4,6,-1,2,4,1,3,7} Compute i) X(0) ii) X(5) iii) $\sum_{k=0}^{9} X(k)$ iv) $\sum_{k=0}^{9} |X(k)|^2$ without computing DFT **08**

### UNIT - II

3 a) Compute 8-point DFT of h(n)=[1,1,-1,-1] using DIF-FFT radix-2 algorithm. Identify what type of filter is this: LPF|HPF|BPF|BSF ? **10**

b) Compute the output y(n) of a filter whose impulse response is h(n)={1,2} and input signal x(n)={1,4,3,0,7,4,-7,-7,-1,3,4,3} using overlap and save method **10**

## UNIT - III

4 a) Design a digital IIR low pass filter using Butterworth approximation for the following analog specifications: **12**

Pass band edge : 500 Hz, Stop band edge : 750 Hz, Pass band gain : -3 dB, Stop band attenuation : -15dB, Sampling Frequency : 2000 Hz. Use Bilinear transformation.

b) Obtain cascade structure for the given system **08**

$$y(n) = \frac{5}{8}y(n-1) - \frac{1}{16}y(n-2) + x(n) + \frac{3}{4}x(n-1) + \frac{1}{8}x(n-2)$$

## OR

5 a) Given $H(s) = \frac{s+1}{s^2+5s+6}$, use impulse invariant transformation to convert this to $H(z)$ . Assume $F_s = 1\,Hz$ **06**

b) Obtain parallel structure for the given IIR system transfer function **08**

$$H(z) = \frac{z(3z+1)}{3(z-\frac{1}{2})(z-\frac{1}{4})}$$

c) What are the limitations of impulse invariance method? Compare FIR and IIR filters **06**

## UNIT - IV

6 a) Design a FIR digital filter using a Hamming window with N=7 **08**

$$H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega} & |\omega| \le \frac{3\pi}{4} \\ 0 & ,\frac{3\pi}{4} < |\omega| < \pi \end{cases}$$

b) Determine the direct form realization and linear phase realization of digital filter with impulse response **06**

h(n)= δ(n)-0.5 δ(n-1)+1/4 δ(n-2)+0.25 δ(n-3)-0.5 δ(n-4)+ δ(n-5)

c) Mention the different types of window functions used in FIR filter design and also write their mathematical expressions. **06**

## UNIT - V

7 a) Given a quadratic MSE function for the Wiener filter: $J = 40 - 20w + 10w^2$. Find the optimal solution for w* to achieve the minimum MSE $J_{\min}$ and determine $J_{\min}$. **04**

b) Apply the LMS algorithm to adaptive filter for the noise cancellation with relevant block diagram. **08**

c) With a neat block diagram explain two stage interpolator and decimator, representing multistage implementation of sampling rate conversion **08**

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