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Dec.-22-0270

EC-604 Digital Signal Processing (ECE)

B.Tech. 6th (CBCS)

Time : 3 Hours **Max. Marks : 60**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, selecting one question each from section A, B, C and D. Section E is compulsory.

SECTION - A

1. Show that a system is casual if and only if its impulse response satisfies the condition h(n) = 0 for $n \leq 0$. A signal $x(t) = \mathrm{Cos}(4\pi t)$ is sampled at 8 Hz. Find The Signal which if sampled at 8 Hz results in same discrete time signals as obtained from x(t). What is The Nyquist rate for signal $x(t) = \mathrm{Sin}(2\pi t)\mathrm{Cos}(2\pi t)$. (10)

2. What are the basic elements of a DSP system? Describe the role of each. What are the advantages/disadvantages of DSP over analog signal processing? (10)

SECTION - B

3. Plot 3h(2n-1)+h(n) for given h(n)=[1,0,3,5,4]. Check the following systems for linearity, causality and time invariance properties: (i) y(n) = nx(n) and (ii) y(n) = x(-n) (10)

4. Compute the convolution of $x(n) = \alpha^n u(n)$ for $-3 \leq n \leq 5$, zero otherwise and h(n) =1 for $0 \leq n \leq 4$, zero otherwise. (10)

SECTION - C

5. Discuss Radix 2 Decimation in Time (DIT) FFT algorithm. Draw the basic butterfly computation diagram in DIT-FFT algorithms. Show how the computational complexity is reduced in FFT algorithm as compared to direct computation of DFT? (10)

6. Compute the 8 point DFT of sequence x(n) = {0 1 2 3 4 5} using Radix 2 Decimation in frequency FFT algorithm. (10)

SECTION - D

7. Discuss the procedure to design a digital Butterworth low pass filter if the 3 dB cut off cutoff frequency ω_c and filter order N are specified. If you wish to design a digital Butterworth low pass filter with cut off frequency of 40 Hz, filter order 4 and sampling frequency 200 Hz, find the transfer function H(s) of corresponding analog filter. Assume bilinear transformation for mapping for s plane to z plane. (10)

8. Draw the frequency response of Ideal Low Pass, High Pass, Band Pass and Band Stop digital filters. Design a Linear phase FIR filter approximating the ideal response

$$H_d(\omega) = \begin{cases} 1. & \text{for } |\omega| \leq \frac{\pi}{6} \\ 0. & \text{for } \frac{\pi}{6} < |\omega| \leq \pi \end{cases}$$

Determine the coefficients of a 11- tap filter based on window method with rectangular window. Determine and plot the Magnitude and Phase response of the filter. (10)

SECTION - E

9. (i) Show that the operation of folding and shifting is not commutative. If a signal x(t) is scaled by a factor of 2, then shifted to left by 1 and then folded, what will the resultant signal.

   (ii) A signal x(n) is obtained from x(t) with 20 kHz sampling rate. How can you change the sampling rate of x(n) to 15 kHz?

   (iii) Discuss the mapping analog frequencies into digital frequencies using bilinear transformation.

   (iv) Find the circular convolution of x(n) = { 1,1,1,1} and h(n)= {1, 0, 0, 1}. (4×5=20)