PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2023

Semester : Semester III - 2021
Course Code : ECE3002
Course Name : Sem III - ECE3002 - Digital Signal Processing
Program : B.Tech. Electronics and Communication Engineering

Date : 9-JAN-2023
Time : 1.00PM - 4.00PM
Max Marks : 100
Weightage : 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.

PART A

ANSWER ALL THE FIFTEEN QUESTIONS   **15 X 2 = 30M**

1. Exact reconstruction of a continuous time base-band signal from its samples is possible, if the signal is band-limited and the sampling frequency is _____ the signal bandwidth.

   (CO1,CO2) [Knowledge]

2. Signal Processing deals with modification and analysis of the acquired time-series data for the purposes of information enhancement. Discrete Fourier Transform (DFT) is applicable for_____length sequences.

   (CO1,CO2) [Knowledge]

3. x(n) is a real sequence and X(k) is its N-point DFT. The 8 point DFT of x(n) is,
   X(k)={28, (-4+9.656j), -4-4j, (-4+1.656j), (-4), _____, (-4+4j), (-4-9.656j)} fill the blank value.

   (CO2,CO1) [Knowledge]

4. Fast Fourier Transform (FFT) algorithm is used to compute a Discrete Fourier Transform (DFT).In FFT algorithm, Number of Addition and Multiplications are reduced.How many complex Additions are need to compute DFT of a N point sequence_____.

   (CO2,CO1) [Knowledge]

5. The Discrete Fourier Transform is a numerical variant of the Fourier Transform. How many complex multiplications are need to compute N point DFT using direct formula?

   (CO2,CO1) [Knowledge]

6. Filter realization is important concept for any LTI system design.
   Name the elements that are used in the realization of a system?

   (CO3) [Knowledge]

7. IIR filters are one of two primary types of digital filters used in Digital Signal Processing applications. Express the property of Infinite Impulse Response(IIR) filter (Recursive/Non recursive)?

(CO3) [Knowledge]

8. Frequency transformation techniques are used to generate High pass filter, Bandpass and bandstop filter from the lowpass filter system function.The transformation technique in which there is one to one mapping from s-domain to z-domain is_____.

(CO3) [Knowledge]

9. Parellel realization of filtering gaining importance for parellel processing of informations. For parellel realization, partial fraction method is followed. For such a structre, The degree of the numerator must be less than the degree of the denominator.Check the statement truthfulness.

(CO3) [Knowledge]

10. Compare to analog filter digital filters are operated with wide range of frequencies.To design a digital filter ,analog filter transfer function is needed (TRUE/FALSE)?

(CO3) [Knowledge]

11. $H_d\left(e^{jw}\right) = \begin{cases} e^{-j2w} & \left(\frac{\pi}{4}\right) < |w| < \pi \\ 0 & otherwise \end{cases}$

for the given desired frequency response, Identify the type of filter.

(CO4) [Knowledge]

12. A filter is described by the following difference equation, y(n)=2x(n)+3x(n-1)+x(n-2)+4x(n-3)+x(n-4)+3x(n-5)+2x(n-6). Write the transfer function H(z) for the above filter.

(CO4) [Knowledge]

13. A particular filter operated over a wide range of frequencies and able to pass the frequency less than given cutoff frequency and attenuating the information of higher frequency. Which is functioning as _____filter.

(CO4) [Knowledge]

14. Linear phase is a property of a filter, where the phase response of the filter is a linear function of frequency. Then related condition of linear phase is_____

(CO4) [Knowledge]

15. Identify the type of filter which is described by the following desired frequency response.

$H_d\left(e^{j\omega}\right) = \begin{cases} e^{(-j\omega)} & |\omega| \leqslant \left(\frac{\pi}{4}\right) \\ 0 & otherwise \end{cases}$

(CO4) [Knowledge]

PART B

ANSWER ALL THE TWO QUESTIONS   **2 X 15 = 30M**

16. In signal processing, the Overlap–Save method is used to evaluate the convolution of a very long signal with a finite impulse. Find y(n) for the given x(n) and h(n) by using the Overlap Save method, where x(n)={1,2,-1,2,3,-2,-3,-1,1,1,2,-1} and h(n)={1,2,3).

(CO1) [Comprehension]

17. A digital system should be designed to produce circular convolution of two equal length sequence. But we are having a system which is able to produce Discrete Fourier Transform and its inverse. Determine the circular convoluted value for the two sequences of x1(n)={1,2,-2,-1} and x2(n)= {-3,-2,1,0} using FFT and IFFT algorithm.

(CO2) [Comprehension]

PART C

ANSWER ALL THE TWO QUESTIONS   **2 X 20 = 40**

18. a) A Butterworth filter is a type of signal processing filter designed to have a frequency response as flat as possible in the passband. Design an Analog Low Pass Butterworth Filter which has a 2db Passband Attenuation at a frequency of 20 rad/sec and a 10db Stopband Attenuation at 30 rad/sec.

b) Realisation of a system means obtaining a network corresponding to the equation or transfer function.

The Direct Form-I realization is the simplest and most straightforward structure for the realization of any system.

For the given difference equation y(n)+2y(n-1)+3y(n-2)=x(n)+5x(n-1), Obtain the Direct Form-I realization structure.   (CO3) [Application]

19. The window method for digital filter design is fast, convenient, and robust, but generally suboptimal. The window method consists of simply windowing a theoretically ideal FIR by some suitably chosen window function. By using a Rectangular Window W(n), Design FIR filter for a given desired response

$$H_d(\omega) = \begin{cases} e^{(-j3\omega)} & for \left(\frac{-\pi}{4}\right) \leqslant \omega \leqslant \left(\frac{\pi}{4}\right) \\ 0 & otherwise \end{cases}$$

Where W(n) is define as

$$W(n) = \begin{cases} 1 & for 0 \leqslant n \leqslant 6 \\ 0 & otherwise \end{cases}$$

Further derive the Frequency Response H(e^jw) and realize the derived Filter H(z) by using the minimum number of multipliers(ie., Linear Phase Structure).

                                    (CO4) [Application]

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