CBCS SCHEME

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21EE63

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Signals and Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. For the following discrete time systems, determine whether the system is : i) Linear ii) Time invariant iii) Memory less iv) Causal v) Stable.

I) $y(n) = x(1-n)$ II) $y(n) = \log_{10}^{(|x(n)|)}$ **(06 Marks)**

b. Sketch the even and odd component of the continuous time signal x(t) shown in Fig.Q.1(b) **(06 Marks)**

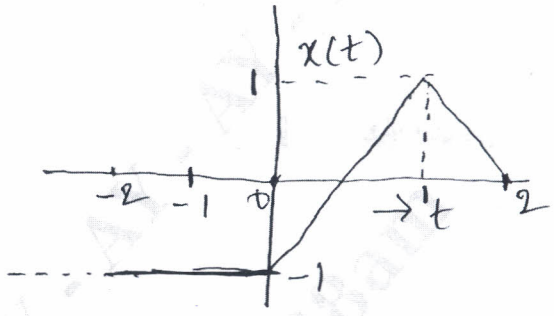

Fig.Q.1(b)

c. Consider an LTI system with unit impulse response $h(t) = u(-t + 2)$. If the input applied to the system is $x(t) = u(t + 2) - u(t - 1)$ find the output y(t) of the system. **(08 Marks)**

OR

2 a. Consider an LTI system with input $x(n) = 2^n u(-n)$ and impulse response $h(n) = u(n)$. Compute the output of the system y(n) and also plot it. **(10 Marks)**

b. Check whether the following discrete time signals are energy or power signals:

i) $x(n) = \begin{cases} 3(-1)^n; & n \geq 0 \\ 0; & n < 0 \end{cases}$ ii) $x(n) = A\delta(n)$ **(06 Marks)**

c. Find the step response for the LTI system represented by $h(t) = e^{-|t|}$. **(04 Marks)**

Module-2

3 a. Let x(n) be a finite length sequence with $X(K) = \{10, \ -2 + j2, \ -2, \ -2 - j2\}$. Using the properties of DFT find the DFT^s of the following sequences i) $x_1(n) = x((n + 2))_4$ ii) $x_2(n) = x(4 - n)$. **(08 Marks)**

b. Prove the periodic property of DFT. **(02 Marks)**

c. Using overlap save method, compute y(n) of a FIR filter with impulse response $h(n) = \{3, 2, 1\}$ and input $x(n) = \{2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1\}$ **(10 Marks)**

OR

4 a. Using frequency domain approach, compute the energy of the 4 point sequence $x(n) = \sin\left(\frac{2\pi}{N}n\right),\ 0 \le n \le 3$ **(08 Marks)**

b. State and prove the following properties of DFT i) Time reversal ii) Circular convolution iii) Multiplication. **(12 Marks)**

Module-3

5 a. Develop an 8-point decimation in frequency FFT algorithm. Draw the complete signal flow graph. **(10 Marks)**

b. Find 4 point circular convolution of x(n) and h(n) using radix-2 DIF-FFT algorithm. $x(n) = \{1, 1, 1, 1\}$, $h(n) = \{1, 0, 1, 0\}$. **(10 Marks)**

OR

6 a. First five points of 8-point DFT of a real valued sequence is given by $x(k) = \{0, 2 + j2, -j4, 2 - j2, 0\}$; Determine the remaining points. Hence find the sequence x(n) using DIF-FFT algorithm. **(10 Marks)**

b. Why FFT is needed? Explain the classification of FFT algorithms. **(05 Marks)**

c. List any two similarities and differences between DIT and DIF algorithms. **(05 Marks)**

Module-4

7 a. Design a chebyshev analog filter with ripple of 0.5dB in the passband $|\Omega| \le 1$ and at $\Omega = 3$, amplitude is down by 3dB. **(10 Marks)**

b. Obtain H(z) using impulse invariance method for following analog filter.

$$H_a(s) = \frac{1}{(s + 0.5)(s^2 + 0.5s + 2)}$$ **(10 Marks)**

OR

8 a. Explain the frequency transformation in analog filters. **(06 Marks)**

b. List the advantages and disadvantages of digital filter. **(04 Marks)**

c. Design a unit band width 3dB digital Butterworth filter of first order by using bilinear transformation. **(10 Marks)**

Module-5

9 a. Obtain the direct form – I, direct form – II, cascade and parallel form realization for the following system $y(n) = 0.75y(n-1) - 0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2)$. **(14 Marks)**

b. List the advantages and disadvantages of FIR filters. **(06 Marks)**

OR

10 a. Design the symmetric FIR lowpass filter whose desired frequency response is given as

$$H2(w) = \begin{cases} e^{-jwt} & \text{for} \quad |w| \le w_c \\ 0\ ; & \text{other wise} \end{cases}$$

The length of the filter should be 7 and $w_c = 1$ rad/sample. Use rectangular window. **(10 Marks)**

b. Realize the following system function in i) Direct form ii) Cascade form

$$H(z) = 1 + \tfrac{3}{4}z^{-1} + \frac{17}{8}z^{-2} + \tfrac{3}{4}z^{-3} + z^{-4}$$ **(10 Marks)**

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