Total No. of printed pages = 3

ECE 181601

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Roll No. of candidate | | | | | | | | | | |

2023

B.Tech. 6th Semester End-Term Examination

DIGITAL SIGNAL PROCESSING

New Regulation (W.e.f. 2017 – 18) & New Syllabus (W.e.f. 2018 – 19)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer the following : (10 × 1 = 10)

(i) The DFT of $x(n)$, i.e. $X(k)$ is defined as $X(k)=$

(a) $X(\omega)|\omega = \frac{2\pi k}{N}$ (b) $X(\omega)|\omega = \frac{2\pi n}{N}$

(c) $X(\omega)|\omega = 2\pi k$ (d) $X(\omega)|\omega = 2\pi n$

(ii) The transfer function of an IIR system is ————————.

(iii) The systems that process data at more than one sampling rate are called ———————— system.

(iv) Down sampling by a factor of D skips.

(a) D samples (b) $D-1$ samples

(c) no samples (d) $D/2$ samples

(v) In impulse invariant transformation, the right half poles of s-plane are mapped into the ———————— of unit circle in z-plane.

(a) exterior

(b) interior

(c) both exterior and interior

(d) none of the above

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(vi) Which of the following rule is used in the bilinear transformation?

(a) Simpson's rule (b) Backward difference

(c) Forward difference (d) Trapezoidal rule

(vii) FIR systems are implemented using ———— structures.

(a) non-recursive

(b) recursive

(c) both recursive and non-recursive

(d) none of the above

(viii) Initial value theorem states that for a causal signal $x(0)=$ ————.

(ix) The circular convolution of two sequences, each of length N yield a sequence of length ————.

(x) The total number of complex multiplications required to computed N-point DFT by radix-2 FFT is ————.

2. (a) Check whether the system is causal or non-causal (2)

$y(n)=x(n)+x(n-2)$

(b) Check whether the system is linear or non-linear (3)

$y(n)=2x(n)+4$

(c) Compute the linear convolution of two sequences : (6)

$$x(n)=\begin{cases}2, n=-2,0,1\\3, n=-1\\0, \textit{elsewhere}\end{cases}$$

$$h(n)=\delta(n)-2\delta(n-1)+3\delta(n-2)-\delta(n-3)$$

(d) Perform deconvolution using Z-transform if the impulse response $h(n)=\{2,1,0,-1,3\}$ and the output $y(n)=\{2,-5,1,1,6,-11,6\}$. (4)

3. (a) Obtain the direct form II realization of the LTI system governed by the equation (5)

$$y(n)=-\frac{13}{12}y(n-1)-\frac{9}{24}y(n-2)-\frac{1}{24}y(n-3)+x(n)+4x(n-1)+3x(n-2)$$

(b) Realize the system with minimum number of multipliers. (3)

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

(c) Determine whether the discrete-time signal is periodic or non. If period, determine the fundamental period. (2)

$$\cos\left(\frac{n}{6}\right)\cos\left(\frac{n\pi}{6}\right).$$

(d) Perform convolution of the following sequences by overlap add method (5)

$x(n)=\{4,4,3,3,2,2,1,1\}$ and $h(n)=\{-1,1\}$.

4. (a) State and prove the time reversal of the sequence property of DFT. (6)

(b) If IDFT $\{X(k)\} = n(n) = (2,1,2,0)$, using properties of DFT (name the property in each question), find : (9)

(i) IDFT $\{X(m-1)\}$

(ii) IDFT $\{X(k) \oplus X(k)\}$

(iii) IDFT $\{X(k)\, X(k)\}$

(iv) Signal energy.

5. (a) Design a band-stop FIR filter to reject frequencies in the range 1 to 2 rad/sec using rectangular window with $N = 7$. (10)

(b) Find the circular convolution of the following sequences. (5)

$x_1(n) = \{1,-1,1,-1\}$ and $x_2(n) = \{1,2,3,4\}$.

6. (a) Determine the DFT of two real sequences using only one FFT flow graph. (10)

$x_1(n) = \{1,1,1,1\}$ and $x_2(n) = \{2,1,2,1\}$ perform FFT only one.

(b) Discuss parametric and non-parametric methods of power spectrum estimation. (5)

7. (a) Explain the errors that arises due to finite length registers in digital filters. (6)

(b) Explain the mapping of poles in impulse invariant method of IIR digital filter. (5)

(c) Find the Z-transform and ROC of the sequence $x(n) = \left(\frac{1}{4}\right)^n \cos\left(\frac{\pi}{3}n\right)u(n)$. (4)