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Question Paper Code : 91489

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Fourth Semester

Electrical and Electronics Engineering

EE 6403 – DISCRETE TIME SYSTEMS AND SIGNAL PROCESSING

(Common to Instrumentation and Control Engineering, Electronics and Instrumentation Engineering)

(Regulations 2013)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

PART – A

(10×2=20 Marks)

1. Distinguish between discrete signal and digital signal representations.
2. If $x(n) = x(n + 1) + x(n - 2)$, is the system causal ?
3. Determine the Z-transform and ROC of the following finite duration signals
   i) $x(n) = \{3, 2, 2, 3, 5, 0, 1\}$
   ii) $x(n) = \delta(n - k)$
4. Compute the convolution of the two sequences
   $x(n) = \{2, 1, 0, 0.5\}$ and $n(n) = \{2, 2, 1, 1\}$.
5. Define twiddle factor. Write its magnitude and phase angle.
6. Compute the number of multiplications and additions for 32 point DFT and FFT.
7. Comment on the passband and stop band characteristics of butterworth filter.
8. Realize the following causal linear phase FIR system function
   $$H(z) = \frac{2}{3} + z^{-1} + \frac{2}{3}z^{-2}$$
9. What is the advantage of Harvard Architecture in a DS Processor ?
10. How is a DS Processor applicable for motor control applications ?

PART – B (5×13=65 Marks)

11. a) Determine the following systems are linear, stability and time invariance of the system :
    i) $y(n) = x(2n)$ (4)
    ii) $y(n) = \cos x(n)$ (4)
    iii) $y(n) = x(n) + nx(n+1)$. (5)

(OR)

b) i) Explain the process of quantization and its error types. (10)
    ii) Compute the Nyquist sampling frequency of the signal $x(t) = 4 \sin c(3t/\pi)$. (3)

12. a) i) Find the Z transform and ROC of $x(n) = r^n \cos(n\theta)\, u(n)$. (6)

ii) Find the inverse Z transform of $X(z) = \frac{z}{3z^2 - 4z + 1}$; ROC $|Z| > 1$. (7)

(OR)

b) Using z-transform determine the response y(n) for $n \geq 0$ if

$$y(n) = \left(\frac{1}{2}\right) y(n-1) + x(n),\ x(n) = \left(\frac{1}{3}\right)^n u(n) y(-1).$$

13. a) i) Summarize the steps of radix – 2 DIT-FFT algorithm. (5)
    ii) Compute the 4 point DFT of the sequence $x(n) = \{0, 1, 2, 3\}$ using DIT and DIF algorithm. (8)

(OR)

b) Find the IDFT of the sequence

$X(K) = \{4, 1 - j\,2.414, 0, 1 - j\,0.414, 0, 1 + j\,0.414, 0, 1 + j\,2.414\}$

Using DIF algorithm.

14. a) Write briefly on the following :
    i) Comparison of Butterworth and Chebyshev Filter. (6)
    ii) A difference equation describing a filter is given by $y(n) - 2y(n-1) + y(n+2) = x(n) + \frac{1}{2} x(n-1)$ obtain direct form II structure. (7)

(OR)

b) Obtain the system function of the digital filter, if the analog filter is $H_a(s) = 1/[(s + 0.2)^2 + 2]$. Using the impulse invariance method and the Bilinear transformation method, obtain the digital filter. (7+6)

15. a) Draw the architecture of a DSP processor for implementing a DSP algorithm. Explain its features.

(OR)

b) i) Name the different addressing modes of a DSP processor. Explain them with an example. **(7)**

ii) Write a note on commercial DSP processor. **(6)**

PART – C **(1×15=15 Marks)**

16. a) The analog signal has a bandwidth of 4 KHz. If we use N point DFT with $N = 2^m$ (m is an integer) to compute the spectrum of the signal with resolution less than or equal to 25 Hz. Determine the minimum sampling rate, minimum number of required samples and minimum length of the analog signal. What is the step size required for quantize this signal ? **(15)**

(OR)

b) Convert the single pole low pass filter with system function $H(z) = \frac{0.5(1+Z^{-1})}{1-0.302\,Z^{-3}}$ into band pass filter with upper and lower cutoff frequencies ωu and ωl respectively. The lowpass filter has 3dB bandwidth and $\omega p = \pi/6$ and $\omega u = 3\pi/4$, $\omega l = \pi/4$ and draw its realization in direct form II. **(15)**
