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Question Paper Code : 50541

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Fifth/Eighth Semester

Electrical and Electronics Engineering

EE 8591 — DIGITAL SIGNAL PROCESSING

(Common to : Electronics and Instrumentation Engineering/Instrumentation and Control Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define energy and power signals.
2. State sampling theorem.
3. State the Parseval's relation of the z – Transform.
4. Give the Discrete Time Fourier Transform pair equations.
5. State any two properties of DFT.
6. Compare the number of multiplications required to compute DFT of a 64-point sequence using direct computation and that using FFT.
7. Write the equation of Hamming window.
8. What is prewarping?
9. Compare floating-point and fixed-point digital signal processors.
10. List any four commercial digital signal processors.

PART B — (5 × 13 = 65 marks)

11. (a) How will you classify the systems based on their properties? Describe each class with their properties. (13)

Or

(b) Elaborate the steps involved in converting analog signals to digital signals, and the errors associated with these processes. (13)

12. (a) (i) Determine the z – transform of the signal $x(n)=(-1)^n u(n)$ and sketch the ROC. (7)

(ii) Find the causal signal $x(n)$ if its z – transform $X(z)$ is given by $X(z)=\dfrac{1+3z^{-1}}{1+3z^{-1}+2z^{-2}}$. (6)

Or

(b) (i) A linear time-invariant system is characterized by the system function $H(z)=\dfrac{3-4z^{-1}}{1-3.5z^{-1}+1.5z^{-2}}$. Specify the ROC of $H(z)$ and determine $h(n)$ for the following conditions (6)

- The system is stable
- The system is causal

(ii) Determine the convolution of the following pair of signals by means of the z – Transform. (7)

$$x_1(n)=\left(\frac{1}{4}\right)^n u(n-1),\ x_2(n)=\left[1+\left(\frac{1}{2}\right)^n\right]u(n)$$

13. (a) Compute the eight-point DFT of the sequence $x(n)=\{1,2,3,4,4,3,2,1\}$ Using the in-place radix-2 decimation-in-time algorithm. (13)

Or

(b) Given $x(n)=2^n$ and $N=8$, find the DFT of $x(n)$ using DIF algorithm. (13)

14. (a) (i) Explain parallel form and cascade structures of IIR systems. (6)

(ii) Describe the procedure of designing linear phase FIR filters using windows. (7)

Or

(b) (i) Discuss the characteristics of the Butterworth filter with the equation of the order and pole positions. (6)

(ii) Describe the characteristics of various types of Chebyshev filters with necessary equations and diagrams. (7)

15. (a) Describe the functional modes of digital signal processors. (13)

Or

(b) Explain the addressing modes supported by digital signal processors. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Convert the analog filter with system function $H_a(s) = \frac{s+0.1}{(s+0.1)^2+9}$ into a digital IIR filter by means of the impulse invariant method. (15)

Or

(b) Convert the analog filter with system function $H_a(s) = \frac{s+0.1}{(s+0.1)^2+16}$ into a digital IIR filter by means of the bilinear transformation method. The digital filter is to have a resonant frequency of $\omega_r = \pi/2$. (15)