

63

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B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

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. What is the region of convergence of z transform?
4. Write the equation of Discrete Time Fourier Transform pair.
5. What is zero padding? What are its uses?
6. How many multiplications and additions are required to compute N-point DFT using radix-2 FFT?
7. Give the equation of the Hamming window.
8. What is prewarping?
9. Mention the important features of Harvard architecture.
10. List any four commercial digital signal processors.

PART B — (5 × 13 = 65 marks)

11. (a) Determine whether or not the system $y(n)=x(-n+2)$ is
- (i) Linear
 - (ii) Causal
 - (iii) Stable
 - (iv) Time invariant
 - (v) Static. (13)

Or

- (b) Describe the sampling and quantization process with an example, and explain aliasing effect. (5+5+3)

12. (a) (i) Find the z-transform with ROC of the signal $x(n) = [3(3)^n - 4(2)^n]u(n)$. (6)

- (ii) Determine the inverse z transform of the following expression using partial fraction expansion. (7)

$$X(z) = \frac{1}{\left(1 - \frac{1}{3}z^{-1}\right)\left(1 - \frac{1}{6}z^{-1}\right)} \text{ ROC } |z| > \frac{1}{3}$$

Or

- (b) (i) A linear time-invariant system is characterized by the system function (8)

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

Specify the ROC of $H(z)$ and determine $h(n)$ for the following conditions:

- (1) The system is stable
- (2) The system is causal
- (3) The system is anticausal

- (ii) Find the linear convolution of

$$x(n) = \{1, 2, 3, 4, 2, 1, 7\} \text{ with } h(n) = \{2, 3, -1, 6\}. \quad (5)$$

13. (a) List and explain the properties of Discrete Fourier Transform with equations. (13)

Or

- (b) (i) Elaborate the steps of radix-2 Decimation in Time (DIT) FFT algorithm. (8)

- (ii) Find circular convolution of the sequences using concentric circle method $x(n) = \{1, 1, 2, -1\}$ and $h(n) = \{1, 2, 3, 4\}$. (5)

14. (a) Determine the coefficients of a linear-phase FIR filter of length $M = 15$ which has a symmetric unit sample response and a frequency response that satisfies the conditions (13)

$$H_r\left(\frac{2\pi k}{15}\right) = \begin{cases} 1, & k = 0, 1, 2, 3 \\ 0.4, & k = 4 \\ 0, & k = 5, 6, 7 \end{cases}$$

Or

65

- (b) Determine the digital transfer function obtained by transforming the following analog transfer function using the impulse invariance method.

Assume $T = 1$ sec. $H_a(S) = \frac{2}{(s+1)(s+4)}$. (13)

15. (a) (i) Explain the functions of the MAC unit. (4)
(ii) Elaborate the principle of pipelining with an example. (9)

Or

- (b) Discuss various types of addressing modes of digital signal processors with suitable examples. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Compute 8 point DFT of the sequence $x(n) = \{1, 2, 3, 2, 1, 2, 3, 2\}$ using the Decimation in Time (DIT) algorithm.

Or

- (b) Compute IDFT of the sequence $X(k) = \{8, 1+2j, 1-j, 0, 1, 0, 1+j, 1-2j\}$ using the Decimation in Frequency (DIF) algorithm.

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