Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 70756

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fifth/Sixth Semester

Information Technology

IT 6502 — DIGITAL SIGNAL PROCESSING

(Common to Computer Science and Engineering/Mechatronics Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is meant by aliasing? How can it be avoided?

2. Find the energy of $(1/4)^n u(n)$.

3. Compute the DFT of the sequence $x(n) = \{1, 1, 1, 1\}$.

4. Perform circular convolution of two sequence $x(n) = \{1, 2, 3\}$ and $h(n) = \{4, 5, 6\}$.

5. Why Impulse invariant transformation is not Suitable for the design of high pass filter?

6. Write the transformation which is used for conversion of analog domain to digital domain by using bilinear transformation.

7. What are advantages of FIR filter over IIR filter?

8. What Condition on the FIR sequence $h(n)$ are to be imposed n order that this filter can be called a linear phase filter? Write the necessary and sufficient condition for the FIR filter to have linear phase.

9. Compare fixed point and floating point numbers.

10. What is dead band?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Check whether the systems described by the following equations are (1) $y(n) = x(n)\cos\omega n$ (2) $y(n) = |x(n)|$. Static or Dynamic, Causal or non causal, Linear or nonlinear, Time variant or invariant, Stable or Unstable. (7)

(ii) Find the response of the system for the input signal, $x(n) = \{1,2,2,3\}$ and $h(n) = \{1,0,3,2\}$. (6)

Or

(b) Determine the inverse Z-transform of $X(z) = 1/1 - 1.5z^{-1} + 0.5z^{-2})$ if

(i) $ROC : |Z| > 1$

(ii) $ROC : |Z| < 0.5$

(iii) $ROC : 0.5 < |Z| < 1$. (13)

12. (a) Find the 8 point DFT of the sequence $x(n) = \{1, 1, 1, 1, 1, 1, 0, 0\}$. (13)

Or

(b) Compute the DFT for the sequence {2, 2, 2, 2, 1, 1, 1, 1}. Using radix -2 DIT - FFT algorithm. (13)

13. (a) Convert the analog filter with transfer function $H(s) = \dfrac{2}{(s+1)(s+2)}$ into digital filter using impulse invariant method. (13)

Or

(b) Design a digital Chebyshev filter satisfying the constraints.

$0.8 \le |H(e^j)| \le 1$ for $0 \le \omega \le 0.2\pi$

$|H(e^j)| \le 0.2$ for $0.6\pi \le \omega \le \pi$

Using Bilinear transformation. (13)

14. (a) Design an Ideal highpass filter with frequency response using hamming window

$$H_d(e^{jw}) = \begin{cases} 0, & -\dfrac{\pi}{2} \le \omega \le \dfrac{\pi}{2} \\ 1, & \dfrac{\pi}{2} \le |\omega| \le \pi \end{cases}$$

Plot the magnitude response for N = 7. (13)

Or

(b) Design an ideal lowpass filter with frequency response using rectangular window.

$$H_d(e^{jw}) = \begin{cases} 1, & -\frac{\pi}{4} \le \omega \le \frac{\pi}{4} \\ 1, & \frac{\pi}{4} \le |\omega| \le \pi \end{cases}$$

Plot the magnitude response for N = 11. (13)

15. (a) Two first order filters are connected in cascaded whose system functions of the individual sections are $H_1(z) = 1/(1 - 0.5\ z^{-1})$ and $H_2(z) = 1/(1 - 0.4\ z^{-1})$. Determine the overall output noise power. (13)

Or

(b) Derive the steady state input and output noise power of an analog to digital converter used in a digital signal processing system. (13)

PART C — (1 × 15 = 15 marks)

16. (a) With neat figures, explain

(i) the modes of operation of DMA. (7)

(ii) data transfer between RAM and I/O device using DMA. (8)

Or

(b) Design a microcontroller based washing machine with sensor and display interface. Also explain its operation and advantages. (15)

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