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Question Paper Code : 20932

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Fourth/Fifth Semester

Electronics and Communication Engineering

EC 3492 — DIGITAL SIGNAL PROCESSING

(Common to : Computer and Communication Engineering/Electronics and Telecommunication Engineering/Medical Electronics)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is zero padding? What are its uses?
2. Determine the unit step response of the LTI system with impulse response, $h(n) = a^n u(n)$, $|a| < 1$.
3. Give the expression for location of poles of a Chebyshev type I filter.
4. Obtain the direct form - I realization for the system, $y(n) = 0.5 y(n - 1) - 0.25 y(n - 2) + x(n) + 0.4 x(n - 1)$.
5. Define Gibbs phenomenon.
6. Obtain cascade realization with minimum number of multipliers. $H(z) = 1/2 + (1/4)z^{-1} + (1/4)z^{-2} + (1/2)z^{-3}$
7. Compare fixed point and floating point arithmetic.
8. Draw the quantization noise model for a first order system.
9. Define sampling rate conversion.
10. What is the need for anti-aliasing and anti-imaging filters in down-sampling and up-sampling of a signal respectively?

PART B — (5 × 13 = 65 marks)

11. (a) Determine and sketch the magnitude and phase response of $y(n) + (1/2)[x(n) + x(n - 2)]$

Or

- (b) Determine $X(k)$, for $N = 8$, using DIT-FFT algorithm for the given function below : $x(n) = 2^n$

12. (a) Design an analog Butterworth filter that has $\alpha_p = 0.5\text{dB}$, $\alpha_s = 22\text{dB}$, $f_p = 10\text{kHz}$ and $f_s = 25\text{kHz}$.

Or

- (b) Using the bilinear transform design a high-Pass filter, monotonic in pass-band with cut-off frequency of 1000 Hz and down 10 dB at 350 Hz. The sampling frequency is 5000 Hz.
13. (a) Design an ideal low-pass filter with a frequency response $H_d(e^{j\omega}) = 1$ for $-\pi/2 \leq \omega \leq \pi/2$; $H_d(e^{j\omega}) = 0$ for $\pi/2 \leq |\omega| \leq \pi$. Find the values of $h(n)$ for $N = 11$.

Or

- (b) Design a high pass filter using hamming window with a cut-off frequency of 1.2 radians/sec and $N = 9$.
14. (a) Find the steady state variance of the noise in the output due to quantization of input for the first order filter. $y(n) = a y(n-1) + x(n)$

Or

- (b) Consider the following second order IIR filter $H(z)$, find the effect on quantization on pole locations of the given system function in direct form and in cascade form. Take $b = 3$ bits. $H(z) = 1 / ((1 - 0.5z^{-1})(1 - 0.45z^{-1}))$
15. (a) Discuss the poly-phase structure of interpolator and decimator.

Or

- (b) Describe the features of adaptive filters and any two applications of adaptive filters.

PART C — (1 × 15 = 15 marks)

16. (a) Compute the linear convolution for the following sequence using overlap-save method. $x(n) = \{1, 2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1\}$ $h(n) = \{1, 2\}$

Or

- (b) Using impulse invariance with $T = 1\text{S}$, determine $H(z)$ if $H(s) = 1 / (s^2 + \sqrt{2}s + 1)$
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