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

Question Paper Code : 20932

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

Fourth/Fifth Semester

Computer and Communication Engineering

EC 3492 – DIGITAL SIGNAL PROCESSING

(Common to : Electronics and Communication Engineering/ Electronics and Telecommunication Engineering / and 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.

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

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 $y(n)+\frac{1}{2}[x(n)+x(n-2)]$

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 $\alpha_p = 0.5dB$, $\alpha_s = 22dB$, $f_p = 10kHz$ and $f_s = 25kHz$.

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

$$H_d\left(e^{jw}\right)=1 \; for \; \frac{-\pi}{2} \le \omega \le \frac{\pi}{2}$$

$$H_d\left(e^{jw}\right)=0 \; for \; \frac{\pi}{2} \le |\omega| \le \pi$$

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.

$$y(n)=ay(n-1)+x(n)$$

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.

$$H(z)=\frac{1}{\left(1-0.5z^{-1}\right)\left(1-0.45z^{-1}\right)}$$

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 $T = 1S$, determine H(z) if

$$H(s) = \frac{1}{s^2 + \sqrt{2s} + 1}$$