Reg. No. : E N G G T R E E . C O M

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

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(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 — $(10 \times 2 = 20 \text{ marks})$

- 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?

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

Or

(b) Using the bilinear transform design a high-Pass filter, monotonic in passband with cut-off frequency of 1000 Hz and down 10 dB at 350 Hz. The sampling frequency is 5000 Hz.

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13. (a) Design an ideal low-pass filter with a frequency response

$$H_d(e^{j\omega}) = 1$$
 for $\frac{-\pi}{2} \le \omega \le \frac{\pi}{2}$

$$H_d(e^{j\omega}) = 0 \text{ for } \frac{\pi}{2} \le |\omega| \le \pi$$

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.

$$y(n) = \alpha y(n-1) + x(n)$$

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.

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

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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.

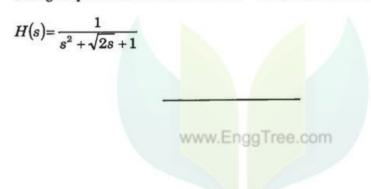
PART C —
$$(1 \times 15 = 15 \text{ marks})$$

16. (a) Compute the linear convolution for the following sequence using overlapsave 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



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