C **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code: R5401

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2025

Fifth Semester

Electronics and Communication Engineering

R21UEC501- DIGITAL SIGNAL PROCESSING

(Regulations R2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (5 x 1 = 5Marks)

1. What is the circular convolution of the sequences $x_1(n)=\{2,1,2,1\}$ and $x_2(n)=\{1,2,3,4\}$ CO2-App

   (a)$\{14,14,16,16\}$ (b)$\{16,16,14,14\}$ (c)$\{2,3,6,4\}$ (d)$\{14,16,14,16\}$

2. The nonlinear relation between the analog and digital frequencies is called CO1- U

   (a) aliasing (b) warping (c) prewarping (d) antialiasing

3. Symmetric impulse response having odd number of samples, N=7 with centre of symmetry α is equal to CO2- Ap

   (a) 2 (b) 5 (c) 3.5 (d) 3

4. If N is unquantized number and N_r is the number quantized by rounding then truncation error is, CO1- U

   (a) N_r - N (b) N – N_r (c) 3 (d) 4

5. In TMS320C5x processors, the maximum number independent circular buffers that can be defined in a program is CO1- U

   (a) 1 (b) 2 (c) 3 (d) 4

PART – B (5 x 3= 15 Marks)

6. State Parsevel's theorem. CO1- U

7. Determine the order of the Chebyshev analog filter for the given specification CO2 -App

   αp = 3 db, αs = 16 db, fp=1 kHz and fs= 2 kHz

8. Write the frequency response of a linear phase LTI system with constant delay and constant group delay. CO1 -U

9. Convert $(-0.125)_{10}$ to one's complement format of binary and verify the result by converting the binary to decimal. CO2 -App

10. Write a short note on MAC unit in DSPs. CO1 -U

PART – C (5 x 16= 80 Marks)

11. (a) Compute 8-point DFT of the discrete time signal, x(n) ={1,2,1,2,1,3,1,3} using Radix-2 DIF FFT. CO2 -App (16)

Or

(b) Compute IDFT for the following sequence $x(n)=(-1)^n$ for N=8 CO2 -App (16)

12. (a) Use the Bilinear transformation to convert the analog filter with system function H(S) = s+0.1/(s+0.1)2+9 into a digital IIR filters. Select T=0.1 and compare the location of the zeros in H(Z) with the locations of the zeros obtained by applying the impulse invariant method in the conversion. CO4-App (16)

Or

(b) Design a butterworth digital IIR filter using Bilinear Transform by taking T= 1 sec to satisfy the following specification CO2- App (16)

$$0.6 \leq |H(w)| \leq 1 \text{ for } 0 \leq w \leq 0.35\pi$$
$$|H(w)| \leq 0.1 \text{ for } 0.7\pi \leq w \leq \pi$$

13. (a) Design a linear phase FIR Band stop filter using rectangular window with cut off $\omega_c = 0.4\pi$ to 0.6π rad/sample by taking N=7 samples CO2- App

Or

(b) Design a linear phase FIR low pass filter with $\omega_c = 0.5\ \pi$ rad/sec by N=7 samples of Ideal frequency CO2- App (16)

$$Hd(ejw) = \{e\text{-}j^{3\omega}, \text{ for } -0.5\ \pi \leq |\omega| \leq 0.5\ \pi$$
$$= 0, \text{ for otherwise}$$

14. (a) Using your understanding of limit cycle oscillations, analyze the system described by the difference equation y(n) = 0.95 y(n–1) + x(n), given that the system uses fixed-point arithmetic with a word length of 5 bits (including the sign bit). Determine the characteristics of any limit cycle oscillations and calculate the filter's dead band. CO2- App (16)

Or

(b) In the IIR system given below the products are rounded to 4-bits (including sign bit). $H(z) = 1 / (1-0.35z^{-1}) (1-0.62z^{-1})$. Find the output round off noise power in a) direct form realization b) cascade realization. CO2-App (16)

15. (a) Identify and explain the different addressing modes of the TMS320C5X processor. Provide relevant examples for each addressing mode. CO1- U (16)

Or

(b) (i) Explain the simplified architecture of the TMS320C6xx processor with the help of a labeled diagram, describing the role of each major component. CO1- U (8)

(ii) Explain any five addressing modes of the TMS320C6xx processor and provide suitable examples for each. CO1- U (8)